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2016-17

भाकृअनुप
ICAR

ICAR-Central Institute of Temperate Horticulture

Old Air Field, P.O. Rangreth, Srinagar 191132
Jammu and Kashmir (India)

CITH
केशीबाग

Annual Report

2016 – 17

ICAR-Central Institute of Temperate Horticulture
Old Air Field, PO-Rangreth, Srinagar 191132
Jammu and Kashmir, India

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Executive Summary

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The ICAR-Central Institute of Temperate Horticulture has emerged as a mega hub for generation of farmer friendly technologies during last decade in various temperate horticultural crops. The Institute along with its Regional Stations are continuously carrying out need based research on temperate horticultural crops to boost the productivity of quality produce. The number of technologies generated at ICAR-CITH is increasing year after year. Presently farmers have adopted many technologies to boost the productivity of their farms. To cater the need of farmers associated with temperate horticultural crops, the research work carried out by Institute and its Regional Station during 2016-17 are briefly summarized below:

Crop Improvement and Biotechnology

The germplasm is the main wealth of any Institute which can be used to breed the new cultivars or to tackle the problems in future. The collection, evaluation and characterization of germplasm of horticultural crops is one of the major objective of the Institute. The Institute has added 67 new germplasm in its field gene bank and its number has reached to 2540 at main centre Srinagar, J&K while Regional Station Mukteshwar is maintaining 103 & 210 germplasm of various fruit and vegetable & flower crops.

In apple, 120 genotypes were evaluated to identify most diverse and superior genotypes and heaviest fruits were harvested from cv. Maharaji (340.10g). To identify the regular and irregular genotype in apple, a total of 13 genotypes were assessed and medium alternanace was shown by Gala Mast, Vance Delicious, Firdous, American Apirouge, Mollies Delicious and Oregon Spur with ABI values of 0.28, 0.33, 0.36, 0.40, 0.41 and 0.44 respectively. In a pre harvest fruit drop study, the spur type cultivars such as Silver Spur (8.14%), Well Spur (6.90%), and Oregon Spur (7.51%) showed the fewer drops as compared to standard cultivar *i.e.* Vance Delicious (9.34%). In evaluation of 18 apple cultivars belonging to Delicious group, spur type and colour strains at Regional Station Mukteshwar, highest fruit yield (46.11 kg/tree) and fruit weight (217.33 g), was recorded in spur type Red Delicious cultivar and Skyline Supreme. Studies on storage life reveal that Skyline Supreme, Red Chief and Bright-N-Early have better shelf-life than other apple cultivars under ambient storage conditions. Physico-chemical characterization of 16 apple germplasm accessions collected from Kumaon hills of Uttarakhand was also done during the period.

In pear, 20 European pear and 4 Asian pear were evaluated and maximum fruit weight (200.1 g) was recorded in cultivar King Pear and maximum fruit length (102.0 mm) in cultivar Santya Braskaya, whereas minimum fruit weight (16.9 g), fruit diameter (29.2 mm) and fruit length (26.8 mm) was recorded in cultivar Devol. Among the Asian pear cultivars, Chinese Sandy pear produces fruits with highest fruit weight (175.6 g). In quince, 20 genotypes were evaluated and fruit weight ranged from 33.73 to 319.56 g. Maximum fruit weight (319.56 g) and fruit length (84.94 mm) was recorded in the genotype CITH-Q-02 and lowest in the genotype CITH-Q-15. The variation was also reported for various fruit traits in kainth at Uttarakhand. In evaluation of 22 cherry selections, maximum fruit weight was recorded in CITH-C-12 (7.97 g) and minimum in CITH C-20 (3.83 g) while among cultivars maximum fruit weight was recorded in Makhmali (7.88 g) and minimum in Awal No. (2.37 g). In plum, 22 cultivars (15 Japanese and 7

European) were evaluated and in case of Japanese plum, maximum yield was recorded in Au-Cherry (28.00 kg/tree) and minimum in Krassivica plum (4.76 kg/tree). In European plum maximum yield was recorded in President Plum (18.26 kg/tree) and minimum in Italian Plum (11.43 kg/tree). During a survey of 12 genotypes of plum, most of the physico-chemical characteristics were found superior in Collection-8, Collection-2 and Collection-5 in Uttarakhand.

In apricot, fifty-nine accessions were evaluated to identify the trait specific genotypes, especially to identify late blooming and early/late maturing genotypes. Yield of top 10 varieties/genotypes ranged from 24.3-57.8 kg/tree whereas, fruit weight of top ten cultivars ranged from 57.27-77.18g. Among commercial cultivars, maximum oil content (39.33 %) was found in New Castle followed by Heartley (38.3 %). Among indigenous genotypes, maximum oil content (50. 25%) was found in CITH-AP-7 with bitter kernel followed by CITH-AP-24 (49.66%) and CITH-AP-13 (49.42%) both with sweet kernel. Evaluation studies in 15 peach and 7 nectarine genotypes was carried out where in peach highest yield was recorded in Red Globe (33.36 kg/tree) while among nectarine cvs. maximum yield was recorded in Fantasia (6.63 kg/tree). In evaluation of peach cultivars at Mukteshwar, most of the chemical characteristics of fruits were found superior in Red June and Florda Sun as compared to other peach cultivars.

In walnut, 136 accessions were evaluated and some trait specific walnut genotypes were identified. Based on desirable traits CITH-W-62 (IC-587085), CITH-W-114 (IC-0622832) and CITH-W-121 (IC-0622836) were found new best genotypes.

In almond, among 22 selections, CITH-Almond-9, CITH-Almond-11, CITH-Almond-14 and CITH-Almond-23 while among 10 cultivars Merced and California Paper Shell were found promising in respect of nut, kernel and yield traits. The cultivars Shalimar, Non Pareil and Primorskij were found better for kernel recovery. Among 18 olive cultivars, highest yield per plant was recorded in cultivars Picholine and Cipressino while maximum oil content on fresh and dry weight basis was estimated in genotype Cipressino. The heaviest fruit were produced by Coratina. In Kiwi fruit highest yield per plant was recorded in Hayward followed by Allison, Abbott and Monty and lowest in Bruno. Studies on maturity indices indicated that cultivars Hayward had attained optimum maturity (days from full bloom to harvest) between 170 to 177 days, (Allison 167 days, Monty 178 days and Abbott 169-176 days). Based on evaluation of 5 cvs for yield and physico-chemical performance at Mukteshwar, Allison and Bruno cultivar of kiwifruit needs to be popularized in the region. In another study regarding improvement of fruit size inferred that 50% fruit thinning improves the fruit characteristics of kiwifruit cultivars Allison and Hayward.

In vegetable crops, 56 genotypes of Kale including 5 checks were evaluated and highest leaf yield (t/ha) was recorded in HW-5 (253.33 t/ha). Among 16 exotic collections of *Alliums* from Central Asia, the EC-862426 was found better for some traits. Some of the species were unique in plant architectire, bulb structure and flavor with respect to local *Alliums*. In garlic, one variety of garlic CITH-G-3 was identified for release for hill zone-1 by variety release committee of AINRP on ONG, DOGR, Rajgurunagar, Pune.

In saffron, apocarotenoid biosynthesis study during flower development stage, storage conditions and under *in-vitro* conditions was done. Standardization of harvesting time in saffron – apocarotenoid value indexing and retention studies for apocarotenoid content of saffron during different drying methods was also carried out.

In ornamental crops, 27 cultivars in chrysanthemum were evaluated for field performance and based on flower yield cultivars Punjab Anuradha, Pusa Sona, Ajay, Holiday Purple and Dirty White were found promising for temperate climate. In lilium, 4 cultivars were evaluated under polyhouse conditions and 3 cultivars under open conditions. Based on flower

yield, flower size and vase life cultivar Pavia was found best for polyhouse conditions while in open conditions, maximum flower were produced by cultivar Brunello and biggest flowers were produced by Litouwen.

In development of superior cultivars in apple through conventional and non-conventional breeding methods, four cross combinations using Prima as one parent were carried out to transfer the trait scab resistance from Prima to commercial apple cultivars. Hybrid plants raised from last year's crosses were evaluated and screened for scab, powdery mildew and aphid infection/ infestation. S-allele typing of hybrids was done using specific primers to reveal the pollinizer potential of these hybrids.

In development of superior varieties and hybrids in solanaceous vegetables, two entries of chilli; CITH-HP-85/13 (18.51 t/ha) and Sel-136-1-2 (18.44 t/ha), three entries of sweet pepper; Nishat-1-Sel-2 (136.94 t/ha), Gold-Sel (31.86 t/ha) and SH-SP-4 (39.56 t/ha), and one entry of brinjal; B-4-9-Sel-1 (84.92 t/ha) performed significantly better than their respective local checks at Srinagar. At Mukteshwar, among 16 genotypes of tomato highest average fruit yield/plant (3.236 kg) was recorded in VL-4. In capsicum, six genotypes were evaluated at Mukteshwar and highest fruit yield/hectare was recorded in CITH-Sel-2 (1204.44 q/ha).

In characterization and diversity analysis for flowering related gene/ genes in almond, floral biology of different cultivars/ genotypes were studied. Phenotyping of almond germplasm for leaf fall and senescence revealed rapid senescence in CITH-A-4 and Makhdoom while IXL and Pranyaj were slow senescing genotypes. The leaves of genotypes with small size tend to age slowly compared to those with larger leaves. In order to genotype the local almond genotypes for S-alleles, primers were designed and tested on the genomic DNA of local almond cultivars. Specific S-alleles were identified among these genotypes

In diagnosis and prognosis of apple viral diseases – spatial and temporal variation in virus infection in apple it was found that the ACLSV was detectable in high concentration during spring and summer months in leaves while ASPV and ASGV were detected in bark and leaf tissue during spring and summer while low detection was found in buds and flowers. To breed nutra-rich varieties/hybrids in root vegetable crops, sufficient crosses were attempted in turnip, radish and carrot.

Crop Production

During the year Institute has supplied about 21352 grafted/budded plants, 50802 scion wood of elite cultivars of temperate fruit crops while in vegetables 82.27 kg of vegetable seed were provided to farmers/ stakeholders.

Apple

For enhancing feathering through plant growth regulators for high quality nursery production in apple, various growth regulator combination were tried and it was found that all treatment of plant growth regulators increased number of feathers, feather length, branching zone and per cent feathered plants compared to control. In a study on climate change impact on phenological stages of different varieties of apple revealed a significant impact of temperature variation on timing of attaining various phenological stages. The impact was more pronounced on the initial or early stages. The canopy architectural engineering experiments and outreach of technologies for temperate fruits were also laid out and demonstrated at various states. In a INM experiment, the treatment comprising of FYM + vermicompost + biofertilizers + inorganic was found best in both pea and cauliflower intercrops in apple orchard exhibiting highest growth and yield followed by FYM + vermicompost + inorganic treatment.

Walnut

In comparison of different training systems, maximum nut efficiency (0.711 nuts/cm^2) was recorded in open center system. Among different thinning levels 20 per cent thinning at alternate years, 30 per cent heading back level regularly and 10+10% thinning + heading back regularly were found best from nut efficiency point of view.

Saffron

In almond-saffron intercropping, maximum saffron equivalent yield (6.31 kg/ha) was recorded in saffron + semi erect type of cultivars. The highest percentage of crocin (3.2%) and safranal (0.03%) was recorded in sole saffron followed by intercropping with erect type of almond cultivars. As there is less effect on various traits, so the saffron + almond cropping system especially erect and semi erect type of cultivars can be successfully inter planted in saffron. In saffron it was observed that midrib placement of fertilizers upper to corm in two splits is the best mode to get utmost results without polluting the environment.

Strawberry

For soilless strawberry production, two cultivars i.e. Chandler and Katrian Sweet were used along with 16 treatment combinations of media involving cocopeat, perlite and vermiculite in different proportions. The treatment combination of cocopeat + vermiculite (50:50) and cocopeat + vermiculite (75:25) were found best for these varieties respectively.

Vegetables

For raising, the cost effective vegetable seedlings (tomato, capsicum, cucumber, lettuce, Chinese cabbage and broccoli), different growing nutrient media were tried under polyhouse conditions at Uttarakhand and media combinations were standardized. For getting round the year supply of vegetables under polyhouse conditions 14 cvs of tomato, 12 cvs of capsicum, 3 cvs. of cucumber were tried at High hills and mid hills conditions of Uttarakhand. Besides experiments were also conducted under AINRP on onion and garlic and AICRP on vegetables.

Composting and nutrient status

In aquatic dissipate management, aquatic dissipate and worm ratio of 15:1 was found best proportion to get utmost benefit in terms of quality, quantity, worm counts and economic returns. The vermicompost was analyzed for microbial population. Bacteria, fungi and actinomycetes in vermicompost were 211, 33.67 and 23.33 $*10^8$ CFU g^{-1} dry VC respectively. The vermicompost was used to prepare nutrient rich dispersible vermiballs, bars and pellets. In order to optimize fertilizer use efficiency and to get optimum fruit yield among various treatments, highest fruit yield as well as fertilizer use efficiency was observed in treatments where 75 per cent of recommended dose of fertilizer was applied through fertigation. To know the soil and leaf nutrient status of apple growing areas of Kashmir was surveyed and deficit areas were identified. In order to identify the nutrient deficiency, a mobile application Nutrient Deficiency Diagnoser and Manager for Apple was developed. The app was developed in three languages covering the common languages of the farmers of the apple growing areas of India. In Uttrakhand, the apple orchard at Chaubatia showed high and significant SOC levels and available P content was more in subsurface than surface soil at the apple orchard of Chaubatia.

Plant Protection

An experiment was carried out to visualize the effect of different weather parameters on the development of major canker and foliar diseases of apple in Nainital district of Uttrakhand. The coefficient of multiple determination (R^2) was calculated as 0.767- 0.917 for major canker and foliar diseases of apple which signifies that 76.70 – 91.70 per cent variation in percent severity of major canker and foliar diseases during the period under report dependent on weather parameters included in these studies. In another study to know the relationship between percent mortality of apple plants by white root rot of apple and edaphic factors, it was observed that there was a definite relationship between percent mortality of apple by *Dematophora necatrix viz a viz* soil temperature and soil moisture. In Consortium research platform on fungal foliar diseases; production and sporulation studies in *Venturia inaequalis*, scab disease management studies in apple, disease management studies for the control of *Alternaria* in apple, pathogenic variability of *Venturia inaequalis*, *in vitro* evaluation of different contact and systemic fungitoxicants against apple scab, molecular characterization of *Venturia inaequalis* isolates - isolated from different apple

growing areas of Kashmir, population structure analysis for estimating genetic divergence and differentiation of *Venturia* isolates, molecular characterization of *Alternaria* isolates through SSR markers and population structure analysis for estimating genetic divergence and differentiation of *Alternaria* isolates was done. For continuous monitoring of different types of borer infestation and their symptoms, surveys were carried out and a total of 183 insect pest specimens along with some natural enemies have been collected from apple, almond, cherry, plum, peach, and walnut. In addition to that willow, ulmus and poplar trees were also monitored for their pest complex and possible shift of these towards major horticulture crops.

Post Harvest Technology

Two drying modes along with 3 cultivars were used for dehydration of plum into prune. Over all study reveals that Italian Plum took less time for dehydration and retained colour and ascorbic acid in addition to relatively higher rehydration ratio. In blending of juices in different ratios, blending of sweet cherry and sour cherry after six months of storage study it was found that blend of 50% sweet cherry + 50 % sour cherry treated with sodium benzoate retained maximum desirable colour *i.e.* brightness, redness and freshness when compared with other blending combinations. This blend was also found superior in retaining vitamin C, desirable blend of acidity and TSS. In blending of plum and apricot juices, 25% apricot + 75 % plum treated with sodium benzoate retained maximum desirable colour when compared with other blending combinations. This blend was also found superior in retaining vitamin C, desirable blend of acidity and TSS. In chilli, 22 accessions were evaluated for capsaicin and dihydrocapsaicin through HPLC analysis and CITH-HP-92-13 was found to have highest capsaicin (4010 µg/g), dihydrocapsaicin (1863 µg/g) and pungency (64160 SHU) values.

Extension and other activities

The ICAR-CITH has made an effort for speedy transfer of various technologies to the farmers by by various extension modes. The Institute has organized 3 crop days (olive, peach and apple), one three days training to line department and technical staff, one three days training programme to supporting staff for enhancing their skill, 7 one day training/ visit of line department/ scientist (6 at Srinagar and 1 at Mukteshwar), 7 student visits/ trainings, 16 one day training/ visits at Srinagar and 32 training/ demonstration activities at Mukteswar and a three days training to farmers of Dirang was organized at Regional Station Dirang (Arunachal Pradesh). The technologies were also directly provided to the farmers through demonstrations and trainings under MGMG, TSP, NMSHE, network projects, livelihood and nutritional improvement of tribal farm women through horticulture programme. The scientist delivered 22 radio/ TV talks and displayed 7 exhibitions at various occasions.

Publication and Awards.

The scientists of ICAR-CITH published 28 research papers, 7 review articles, 3 books, 6 book chapters, 4 popular articles and 6 extension bulletin/ folders for the benefit of students, researchers, extension functionaries and farmers. The scientists of ICAR- CITH received 10 awards during the year.

Introduction

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India is gifted with diverse agro-climatic regions which are favorable for producing a large number of horticultural crops. After independence, the area, production, productivity and availability of fresh horticultural crops has increased many fold. The constant endeavor made in horticulture sector during last few decades has resulted India to become the second largest producer of fruit and vegetables in the world. Recently, even horticultural production surpasses the food grain production which shows the significance of this sector in contributing to national GDP. The seasonal variability of different regions became an opportunity and made possible round the year supply and availability of fresh horticultural produce. India occupies an important position in the farming system especially in temperate horticultural crops. The North Western and Eastern Himalayan states with temperate climate have monopoly in production of temperate horticultural crops viz. fruits, vegetables, ornamentals, medicinal and aromatic plants and play a pivotal role in nurturing and sustaining socio-economic status of the farmers of the region. Temperate fruit crops are the back bone of national economy and provides livelihood to about 50-60 percent of the population of North West Himalayan region. However our production share in global market of different crops is very low being 2.30% in apple, 1.90 % in apricot, 1.34% in pear, 1.90% in plum, 1.15% in peaches and 0.58% in cherries. Among various temperate fruits like apple, pear, plum, apricot, peach, cherry, kiwifruit, walnut and almonds grown in different area of the regions, apple has monopoly, covering 54% area and 82% of temperate fruit production. Similarly, in vegetables, European type cultivars of cole, bulb, root crops, high value leafy vegetables (lettuce, parsley, celery and Chinese cabbage) asparagus, artichoke, cucumber, capsicum and peas are commercially important. In floriculture, tulip, lilium, alstroemeria, carnation, gladiolus and gerbera are major ones and becoming increasingly significant in the recent years as high value crops. Besides above, a very high value and low volume crops like saffron and kalazeera are exclusively grown in these regions which have high commercial value and domestic & international demand. Despite of manifold increase in national area, production and productivity, still India's position is far behind as compared to average world productivity. There are many constraints which have led to low productivity and substandard quality of produce. In one hand the adoption of viable technologies and optimum use of available resources is very sluggish in the regions because of several challenges and on the other hand temperate horticultural research and development is still at an infancy stage. The ICAR-CITH is a national institute paying a greater role in designing and developing research and extension programmes on various significant aspects of temperate horticultural crops for achieving economic and nutritional security in the entire Indian Himalayan region. The adoption of novel technologies can serve a better alternative to increase the productivity, production of quality produce, nutritional security and uplifting of socio-economic condition of farmers. The ICAR-CITH as an apex organization has shown a path in the development of result oriented and viable technologies and constantly striving for the solution of problems faced by farmers time to time. For crop and product diversification the institute is also working on possibility of growing other emerging horticultural crops, generation of technologies for minimizing pre-post harvest losses and skill/entrepreneurship development. To meet-out current burgeoning challenges, climate change and production constraints, the

research and development activities on temperate horticultural crops is being carried out both at ICAR-CITH main campus, Srinagar and at its two Regional Stations one at Mukteshwar (Uttarakhand) and other at Dirang, Arunachal Pradesh with the following mandate and objectives.

Mandate

- To act as national repository of germplasm & scientific information on temperate horticultural crops.
- To undertake basic, strategic and applied research on temperate horticultural crops in collaboration with national and international agencies to enhance productivity and quality.
- To serve as centre of training for human resource development & transfer of technology.

Objectives

- Establishment of field gene bank and management of genetic resources and scientific data base of temperate horticultural crops.
- Genetic improvement of temperate horticultural crops for yield, maturity, quality, resistance to biotic and abiotic stresses through conventional breeding methods and use of biotechnological tools.
- Standardization of nursery management and high tech propagation techniques of temperate horticultural crops.
- To device efficient and cost effective production technologies and cropping systems for increasing productivity and improving quality of temperate horticultural crops.
- To develop eco-friendly integrated diseases/ pest management modules and diagnostics.
- Post harvest value addition, product diversification and waste utilization for increasing availability and returns.
- To work out economics of production and impact assessment of technologies.
- Commercialization and transfer of technologies and skilled manpower development.

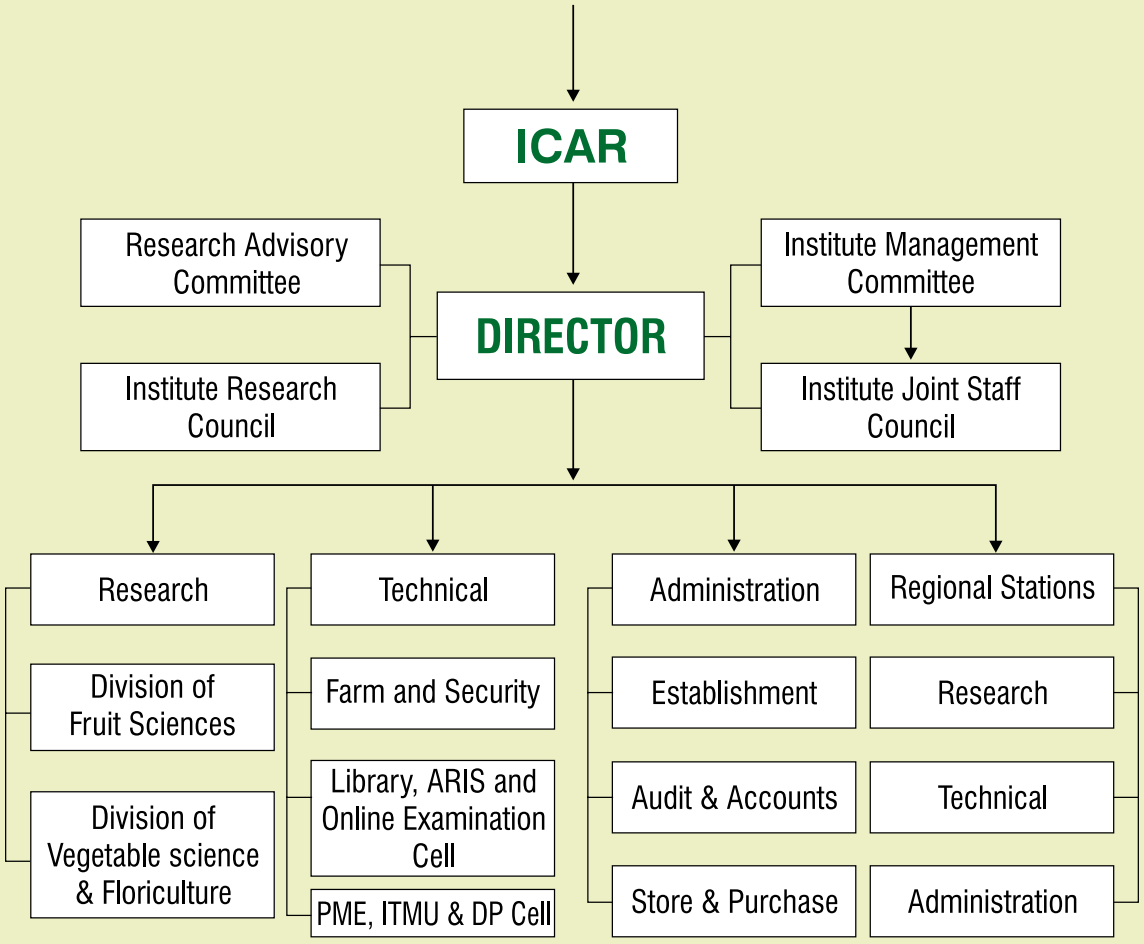
Staff Position (2016-17)

Category	Sanc-tioned	Filled (as on 31st March, 2017)	Vacant (as on 31st March, 2017)
Scientific	22+1RMP	13+1	9
Administrative	15	14	1
Technical	16	13	3
Supporting	19	11	8
Total	73	52	21

Financial Statement (2016-17)

S. No.	Sub-Head	Plan (In lakhs)	Non-Plan (In lakhs)
1	Establishment Charges	0.00	378.21
2	T.A	11.48	4.94
3	HRD	2.99	0.30
4	Contingency	175.28	197.59
5	Equipment	3.06	1.90
6	I.T	0.89	0.00
7	Works	39.58	0.00
8	Library	1.42	0.00
9	Furniture and Fixture	0.86	0.34
10	Network project	69.37	0.00
11	Pension	0.00	16.70
12	Loans and advances	0.00	0.78
Total		**304.93**	**600.76**

ORGANOGRAM OF ICAR-CITH



Research Achievements

3

1. Crop Improvement

Genetic variability is the pre-requisite for any plant breeding program. The development of novel superior cultivars generally is based on available genetic resources. Germplasm collection and characterization are pre requisite and essential steps of breeding programs. Germplasm collection and characterization in horticulture crops are mainly performed by describing economically important horticultural traits and their productivity is directly dependent on the superiority of the genotypes. The fruit crops have several inherent problems such as high heterozygous nature, low seed content, long breeding cycle, polyploidy, self incompatibility etc. which make them difficult to breed genotype having desirable traits. Due to this complex nature of fruit crops, most of the improvement work across the world has been done through selection means only. The majority of cultivars of temperate fruit crops are introduced from various temperate regions of the world. Beside this, the continuous seed propagation of some crops in past also offered a great scope for selection of genotypes with superior quality. The ICAR-CITH, Srinagar and its regional station Mukteshwar are constantly engaged in identification of superior cultivars/ genotypes suitable for commercial cultivation and sustaining the livelihood of entire temperate region of country. The detailed research work carried out on crop improvement during 2016-17 is presented project wise below:

Survey, collection, evaluation, characterization and documentation of temperate horticultural crops

The ICAR-CITH is a premier institute in temperate horticultural crops in India that has made continuous efforts for collection, characterization and conservation of germplasm from different regions of India and other parts of the world. The institute is acting as national active germplam sites and repository of temperate horticultural crop germplasms for evaluation and its further use in designing future breeding and conservation strategies. The Western Himalaya is bestowed with great diversity for many temperate fruit crops, thus offers a great scope for selection. During 2016-17, institute has added 67 new genotypes in various temperate horticultural crops and the total number has reached up to 2540 (Table 1). The germplasm accessions were introduced in the form of plants, scion wood, cutting, rootstocks etc. Similarly at Regional Station, Mukteshwar about 103 accessions of fruits and 210 accessions of vegetables & ornamentals are being maintained and evaluated.

Table 1. Status of germplasm collected and conserved at ICAR-CITH (2016-17)

S. No	Crop/ Group	Germ-plasm status (2015-16)	Added (2016-17)	Total germ-plasm (2017)
1	Fruits:	1088	41	1129
	Pome	361	11	372
	Stone	194	16	210
	Nuts	359	9	368
	Others	174	5	179
2	Vegetables	1050	9	1059
3	Ornamentals	310	17	327
4	Medicinal & Aromatic plants	25	00	25
	Total	**2473**	**67**	**2540**

Apple

Genetic variability for horticultural and morphological traits among apple (*Malus domestica* Borkh.) genotypes

In apple, to identify most diverse and superior genotypes, a total of 120 accessions of apple were evaluated for various qualitative and quantitative horticultural traits. The selected apple genotypes showed a considerable genetic diversity and differed significantly for various studied traits. The fruit weight ranged from 1.30-340.10g with the mean of 152.84g. Simmilarly, highest fruit weight of 340.10g was recorded in Maharaji while, lowest 1.30g was in CITH-A-MB-03. Fruit firmness (RI) ranged from 44.59 to 91.70 with an average of 65.88. The total soluble solids (TSS ^{o}B) ranged from 9.50 to 28.80 with an average of 16.77. Among fruit color value, L^* values ranged from 22.05 in (CITH-A-MB-03) to 76.55 in Anannas Retrine however, negative a^* values were recorded in 19 apple genotypes. Values for b^* ranged from 60.93 (CITH-A-MB-03) to 43. 18 (Apple Queen) and no accession showed negative b^* value. Hue^{o} values ranged from 5.43 (Summer Red) to 171.78 (CITH-A-MB-03). The cluster analysis grouped 120 genotypes into five distant clusters at 0.70 average distances.

Yield (kg/tree) and Alternate Bearing Index of apple cultivars on MM-106 at 2.5m x 2.5m spacing

To identify the regular and irregular genotype in apple, a total of 13 genotypes were assessed based on quantitative evaluation of alternation for determining the alternate bearing index (ABI) which, take into the fruit production of the cultivars to define the alternate bearing. Medium alternanace was shown by Gala Mast, Vance Delicious, Firdous, American Apirouge, Mollies Delicious and Oregon Spur with ABI values of 0.28, 0.33, 0.36, 0.40, 0.41 and 0.44 respectively (Table 2). Cultivars Starkrimson, Cooper-IV, Golden Delicious, Silver Spur and Red Chief are susceptible to alternanace with ABI values of 0.52, 0.54, 0.61, 0.62 and 0.68 respectively. High degree of alternanace was shown by Red Delicious and Red Fuji with ABI values of 0.71 and 0.83 respectively. Thus have more tendency to alternance than other cultivars under study.

Table 2: Yield (kg/tree) and alternate bearing index of apple cultivars on MM-106 at 2.5m x 2.5m spacing

Cultivar	2012-13	2013-14	2014-15	2015-16	2016-17	ABI/BBI
Red Chief	16.16	18.06	22.40	40.95	38.75	0.68
Oregon Spur	21.42	23.88	27.00	41.23	31.39	0.44
Silver Spur	12.59	17.73	12.60	20.36	26.89	0.62
Starkrimson	18.22	10.20	9.75	30.30	34.52	0.52
Cooper-IV	19.51	20.26	22.57	33.06	35.10	0.54
Red Fuji	7.98	7.69	8.88	7.62	30.48	0.83
Gala Mast	29.65	8.64	17.93	27.00	28.38	0.28
Mollies Delicious	24.15	15.52	16.02	20.13	33.45	0.41
Red Delicious	11.51	13.80	15.20	29.29	32.02	0.75
Vance Delicious	9.12	12.64	25.20	12.72	10.79	0.33
Golden Delicious	19.45	17.75	22.75	37.10	40.29	0.61
American Apirouge	20.63	17.38	16.80	22.32	28.05	0.40
Firdous	11.23	11.66	13.11	18.75	14.13	0.36
CD at 5%	*3.2*	*2.7*	*2.2*	*3.6*	*4.2*	*NS*

Response of apple genotypes for pre-harvest fruit drop

Pre-harvest fruit drop is one of the major problem in apple cultivation and causing significant losses to growers. To overcome this problem, during the year 2016, a total of 22 apple genotypes planted at a spacing of 4m x 4 m (625 plants/ ha) on a seedling rootstock were evaluated for the pre-harvest fruit drop under uniform management conditions. Among the genotypes evaluated, the fruit drop ranged from 6.64 to 40.12 per cent. Initial results revealed that the early varieties showed maximum drop, ranging from (12.86 to 40.12%) with the average 26% (Fig.1). The earliest variety (Vista Bella) which matures in the month of June showed highest fruit crop of (40.12%). The spur type cultivars as Silver Spur (8.14%), Well Spur (6.90%), and Oregon Spur (7.51%) showed the fewer drops as compared to standard cultivars *i.e.* Vance Delicious (9.34%). Among the evaluated genotypes two mid-season maturing cultivars Akbar (15.35%) and Green Sleeves (20.5%) showed exceptional percentage of pre-harvest drop which be might due to high average fruit weight of these varieties.

Pear

Genetic variability in pear (*Pyrus communis* and *Pyrus pyrifolia*.) genotypes for horticultural traits

In pear, during the year 2016, a total of 24 genotypes of pear were evaluated for different quality associated attributes. Among 20 evaluated European pear cultivars maximum fruit weight (200.1 g), and fruit diameter (75.3 mm), were recorded in cultivar King Pear and maximum fruit length (102.0 mm) in cultivar Santya Braskaya, however minimum fruit weight (16.9 g), fruit diameter (29.2 mm) and fruit length (26.8 mm) was recorded in cultivar Devol. Among the Asian pear cultivars, Chinese Sandy Pear produces fruits with highest fruit weight (175.6 g), fruit length (58.9 mm) and fruit diameter (70.2 mm) and minimum in cultivar Kashmiri Nakh (Table 3&4). Maximum TSS and acidity were recorded in cultivars Japanese pear (14.0° B).

Fruit firmness in European cultivars ranged from 46.7-79.9 RI, while in Asian cultivars it ranged from 65.1- 82.0 RI with an average of 75.0 RI. The colour characteristics (L^*, a^* and b^*) of European pear cultivars were determined on sun-exposed plant of each fruits. The L^* values range from 31.1 in (King Pear) to 66.6 in (Max Red Bartlett), negative a^* values were recorded in 09 pear genotypes. Values for b^* scale ranged from 4.2 (Starkrimson) to 46.1 (Max Red Bartlett) and no accession showed negative b^* value. In case of Asian pear cultivars the L^* values range from 42.1 in (Kashmiri Nakh) to 58.9 in (Japanese pear), negative a^* values were recorded in 02 Asian pear genotypes. Values for b^* scale range from 22.4 (Kashmiri Nakh) to 30. 0 (Badshah Nakh) and no accession showed negative b^* value.

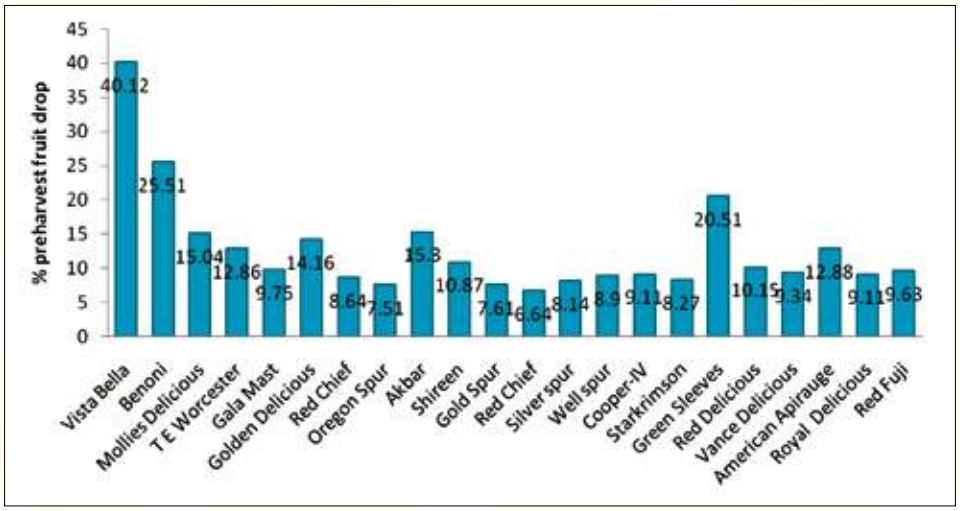


Fig. 1: Response of 22 apple cultivars to pre-harvest fruit drop

Max Red Bartlett

William Bartlett

Santya Braskaya

Fertility

Louise Bon de Jersey

Vikar of Winkfield

Fruiting in different cvs. of European pear at ICAR-CITH, Srinagar

Table 3. Physico-chemical characteristics and colour attributes of different European Pear cultivars

Cultivars	Fruit Weight (g)	Fruit length (mm)	Fruit Diameter (mm)	TSS (°B)	Acidity (%)	Firmness (RI)	Colour			
							L*	a*	b*	Tint
William Bartlett	180.3	76.1	66.1	16.1	0.4	55.0	58.0	2.2	37.5	-13.1
Mayan	145.1	65.8	62.4	12.6	0.2	56.5	61.5	-1.4	39.6	-15.5
Monarch	123.9	65.9	60.9	11.2	0.6	79.3	66.3	1.4	44.1	-26.4
Louise Bonne de Jersey	111.0	67.1	56.7	15.1	0.9	48.9	59.5	-1.7	35.8	-13.5
Smart	114.6	65.0	57.9	9.50	0.6	48.3	52.5	-2.3	28.7	-15.5
Besri-de-Amanalis	153.8	74.8	64.0	11.7	0.6	67.4	58.6	-2.1	36.1	-11.6
Wiker of Winkfield	100.9	77.4	50.6	18.4	1.0	46.7	57.4	-2.2	30.8	-9.6
Doyenne du Comice	94.7	64.8	53.4	11.2	1.9	82.2	61.4	0.2	36.1	-19.4
Devol	16.9	26.8	29.2	18.3	0.	52.4	44.1	-2.2	18.4	-4.5
Moon Glow	116.5	67.1	55.6	12.0	0.6	73.6	61.2	-1.6	42.2	-16.4
Santya Braskaya	87.1	102.0	48.7	12.1	0.8	77.3	63.3	-0.3	35.1	-16.6
Max Red Bartlett	154.5	80.9	62.4	11.3	0.7	65.6	66.6	6.2	46.1	-33.8
Severenta	112.5	62.5	57.5	12.2	0.8	61.5	57.3	5.9	41.3	-41.3
Starkrimson	188.0	80.6	68.3	11.2	0.8	64.9	34.1	14.2	4.2	-51.4

Cultivars	Fruit Weight (g)	Fruit length (mm)	Fruit Diameter (mm)	TSS (°B)	Acidity (%)	Firmness (RI)	Colour			
							L*	a*	b*	Tint
Gent Drouard	127.3	64.4	62.6	10.0	0.6	55.4	54.8	-3.1	34.1	-9.1
Fertlity	165.3	85.3	66.3	13.1	0.9	65.6	56.8	4.21	29.5	-6.6
King Pear	200.1	90.0	75.3	11.8	0.4	79.9	31.1	6.5	22.6	6.9
Hayward	199.5	83.2	68.0	12.5	0.9	73.0	56.5	5.5	33.7	2.3
Flemish Beauty	152.0	63.	59.6	10.5	0.7	75.1	45.3	4.5	2.31	1.4
Doyenne Burrah	190.0	83.0	66.8	9.70	0.9	76.8	56.8	4.2	29.5	-6.6
CD at 5%	*28.5*	*8.78*	*5.01*	*0.38*	*0.2*	*4.04*	*3.52*	*2.03*	*3.53*	*7.45*

Table 4 Physico-chemical characteristics of different Asian pear cultivars .

S. No	Cultivars	Fruit Weight (g)	Fruit length (mm)	Fruit Diameter (mm	TSS (°B)	Acidity (%)	Firmness RI	colour			
								L*	a*	b*	Tint
02	Kashmiri Nakh	74.5	51.7	48.5	9.4	0.7	65.1	42.1	9.5	22.4	-53.54
03	Badshahnakh	128.3	52.7	53.8	12.1	0.9	75.16	53.4	-2.9	30.0	-8.53
04	Japanese pear	160.6	56.0	69.8	14.0	0.8	78.12	58.9	-3.0	27.2	-4.30
04	Chinese sandy pear	175.6	58.9	70.2	11.0	0.10	82.0	51.4	3.8	25.9	-0.31
CD at 5%		*13.8*	*3.8*	*4.0*	*0.4*	*0.2*	*6.17*	*2.97*	*1.69*	*NS*	*8.52*

Kashmiri Nakh

Badshah Nakh

Japanese Pear

Chinese Sandy pear

Fruiting in different Asian pear cultivars

Quince

Assessment of genetic variability in Quince (*Cydonia oblonga* Mill)

A wide range of variability were noticed in quince genotypes at ICAR-CITH, Srinagar. Varition recorded in shapes, sizes, productivity levels, quality and taste attributes as well as the ripening times. Among evaluated 20 quince genotypes, fruit weight ranged from 33.73 -319.56 g and maximum fruit wt. (319.56 g) and fruit length (84.94 mm) was recorded in the genotype CITH-Q-02 and lowest in the genotype CITH-Q-15. The maximum fruit diameter (84.65 mm), was recorded in genotype CITH-Q-04 and lowest (35.78 mm) in genotype CITH-Q-15. The TSS ranged from 11.4-18.6 °B, where maximum TSS was recorded in genotype CITH-Q-12 (18.6 °B) and minimum (11.4 °B) in genotype CITH-Q-16. The titrable acidity in genotypes ranges from 0.6-1.7%, where maximum acidity was recorded in genotype CITH-Q-14 and minimum in CITH-Q-20. Likewise fruit firmness ranged from 73.5-85.3 (RI). The colour characteristics (L^*, a^* and b^*) of quince genotypes were determined on sun-exposed side of each fruit, where L^* ranged from 58.23-84.17, a* value ranged from -1.33 to – 4.77 and the b* value ranged from 7.61 to 57.23 (Table-5).

Table. 5 Variation for physico -chemical and quality attributes of Quince (*Cydonia Oblonga* Mill.) genotypes

Genotype	Fruit Weight (g)	Fruit length (mm)	Fruit Diameter (mm)	TSS (°B)	Acidity (%)	Firmness RI	Colour		
							L*	a*	b*
CITH-Q-01	194.78	66.39	72.73	13.8	1.6	81.5	76.32	-4.77	36.16
CITH-Q-02	319.56	84.94	84.65	12.2	1.6	82.6	75.16	-1.53	38.23
CITH-Q-03	212.38	79.97	74.23	15.6	0.7	82.5	60.73	-1.33	37.47
CITH-Q-04	213.70	86.07	72.67	11.5	0.8	82.2	58.23	-0.47	39.27
CITH-Q-05	190.64	77.96	70.25	14.7	1.1	83.3	62.86	-2.57	45.23
CITH-Q-06	175.13	69.37	71.32	12.4	0.7	80.8	79.25	-1.57	56.42
CITH-Q-07	227.92	77.37	76.35	11.6	1.0	85.3	56.14	-4.37	57.18
CITH-Q-08	164.86	70.37	68.49	15.2	1.2	85.1	64.61	-1.08	10.17
CITH-Q-09	126.43	70.23	62.37	13.8	1.3	78.0	82.27	-1.53	7.61
CITH-Q-10	95.93	47.03	50.99	12.4	1.1	77.2	84.17	-3.99	9.83
CITH-Q-11	185.90	82.17	68.53	14.9	1.5	83.8	73.10	-3.87	13.38
CITH-Q-12	142.47	69.33	64.07	18.6	0.9	84.8	63.57	-1.37	42.77
CITH-Q-13	182.27	81.77	64.99	17.9	1.1	80.2	77.23	-1.34	57.23
CITH-Q-14	62.72	59.35	46.69	14.7	1.7	84.7	65.31	-2.87	42.93
CITH-Q-15	33.73	36.43	35.78	13.7	1.4	81.3	64.63	-1.68	39.20
CITH-Q-16	79.23	39.03	45.47	11.4	0.8	73.5	58.96	-2.45	37.34
CITH-Q-17	75.77	59.33	49.77	12.5	0.9	76.2	69.23	-1.59	34.63
CITH-Q-18	71.87	59.36	40.92	12.1	0.8	76.4	61.43	-2.53	44.28
CITH-Q-19	68.17	65.96	48.73	14.1	0.9	80.2	70.37	-4.47	50.27
CITH-Q-20	155.97	82.08	66.23	16.1	0.6	84.0	67.95	-2.09	40.93
CD at 5%	*20.77*	*5.67*	*4.66*	*0.37*	*0.18*	*3.17*	*4.69*	*2.52*	*4.28*


CITH-Q-01


CITH-Q-02


CITH-Q-03


CITH-Q-04


CITH-Q-05


CITH-Q-06


CITH-Q-07


CITH-Q-12


CITH-Q-13

Fruiting in some quince genotypes

Cherry

In cherry selections, maximum fruit weight was recorded in CITH-C-12 (7.97 g) and minimum in CITH C-20 (3.83 g). The maximum pulp stone ratio was found in CITH C-03 (24.63) and minimum in CITH C-06 (13.62) however, maximum TSS was found in CITH C-08 (21.5 ^{0}B) and minimum in CITH C-10 (11.3). Maximum yield was recorded in CITH C-05 (23.77 kg/tree) and minimum in CITH C-18 (3.60 kg/tree). Among cherry cvs. maximum fruit weight was recorded in Makhmali (7.88 g) and minimum in Awal No (2.37 g) whereas, maximum pulp stone ratio was recorded in Lapins (30.37) and minimum in Awal No (6.01). The maximum TSS (18.5^{0}B)and yield was recorded in Lapins and Sweet Heart (18.03 kg/tree) and minimum in Van (9.90 ^{0}B) and Lambert (8.07 kg/tree), respectively (Table 6 & 7).

Bigarreau Noir Grossa (Mishri)

Bigarreau Napoleans (Double)

CITH-C-21

CITH-C-04

Fruiting in some cherry cultivars and selections

Table 6: Physico-chemical characteristics of different cherry selections

Selections	Fruit weight (g)	Fruit Diam-eter (g)	Stone weight (g)	Pulp weight (g)	Pulp stone ratio	Fruit stalk length (mm)	Fruit stalk weight (g)	Fruit stalk di-ameter (mm)	Firmness (RI)
CITH C-01	7.83	24.73	0.37	7.46	20.20	33.62	0.09	1.05	38.78
CITH C-02	7.88	24.68	0.41	7.48	18.44	45.81	0.12	1.14	31.33
CITH C-03	7.87	22.89	0.31	7.56	24.63	31.03	0.07	1.11	36.67
CITH C-04	5.57	21.72	0.28	5.29	18.81	41.07	0.13	1.34	25.63
CITH C-05	6.41	22.46	0.30	6.11	20.48	32.92	0.09	1.09	29.58
CITH C-06	6.18	21.59	0.42	5.76	13.62	46.78	0.12	1.11	60.93
CITH C-07	6.55	23.65	0.32	6.23	19.51	60.96	0.13	1.21	24.70
CITH C-08	5.63	21.39	0.37	5.25	14.22	48.46	0.11	1.14	50.01
CITH C-09	5.81	21.52	0.33	5.48	16.67	43.21	0.13	1.14	38.08
CITH C-10	5.72	21.49	0.29	5.43	18.42	44.85	0.11	1.37	34.83

CITH C-11A	5.72	21.49	0.29	5.43	18.42	50.99	0.14	1.38	34.83
CITH C-11B	5.79	21.02	0.26	5.53	21.31	52.67	0.15	1.13	32.63
CITH C-12	7.97	23.95	0.39	5.59	19.62	59.59	0.15	1.22	35.66
CITH C-13	7.43	23.77	0.45	6.98	15.57	47.43	0.12	1.07	47.82
CITH C-14	7.03	23.63	0.36	6.67	18.43	43.37	0.12	1.16	56.20
CITH C-15A	6.68	23.02	0.30	6.38	21.33	45.31	0.12	1.11	35.77
CITH C-15B	6.55	22.87	0.33	6.23	19.02	44.12	0.09	1.08	41.72
CITH C-16	7.60	24.50	0.39	7.23	18.71	42.59	0.10	1.10	43.97
CITH C-17	6.99	23.47	0.35	6.64	19.09	43.15	0.10	1.14	43.22
CITH C-18	7.66	24.37	0.43	7.23	16.95	37.67	0.11	1.14	39.32
CITH C-19	5.69	21.55	0.33	5.36	17.17	35.80	0.09	1.14	26.05
CITH C-20	3.83	24.36	0.15	3.69	16.20	27.62	0.07	0.70	17.77
CD at 5%	*1.46*	-	*0.07*	*1.40*	-	*9.14*	*0.03*	*0.22*	*9.62*

Table 7: Physico-chemical characteristics of different cherry cultivars

Cultivars	Fruit weight (g)	Fruit diameter (g)	Stone weight (g)	Pulp weight (g)	Pulp stone ratio	Fruit stalk length (mm)	Fruit stalk weight (g)	Fruit stalk diameter (mm)	Firmness (RI)
Mishri	3.10	15.55	0.25	2.84	11.64	61.77	0.18	1.19	40.42
Double	6.55	22.89	0.27	6.28	23.31	35.08	0.11	1.11	31.80
Bing	5.40	21.11	0.33	5.07	15.72	44.16	0.13	1.23	39.10
Van	7.08	23.57	0.35	6.73	19.24	48.81	0.15	1.17	27.83
Lapins	7.47	23.53	0.24	7.23	30.37	50.05	0.17	1.18	41.73
Makhmali	7.88	24.77	0.45	7.43	16.66	61.68	0.50	1.17	45.13
Stella	5.89	23.39	0.36	5.54	15.59	45.44	0.15	1.16	35.13
Sweet Heart	6.73	22.91	0.29	6.44	22.78	45.74	0.13	1.15	15.63
Lambert	6.52	24.86	0.54	5.99	11.26	43.86	0.15	1.14	27.37
Aval No.	2.37	14.42	0.34	2.03	6.01	41.27	0.11	1.15	22.37
CD at 5%	*0.76*	*1.14*	*0.04*	*0.75*	*2.49*	*2.56*	-	*0.03*	*3.13*

Apricot

In apricot, fifty-nine accessions were evaluated to identify the trait specific genotypes, especially to identify late blooming and early/late maturing genotypes. Yield of top 10 varieties/genotypes ranged from 24.3-57.8 kg/tree (Fig. 2) and fruit weight of top varieties ranged from 57.27-77.18g (Fig. 3).

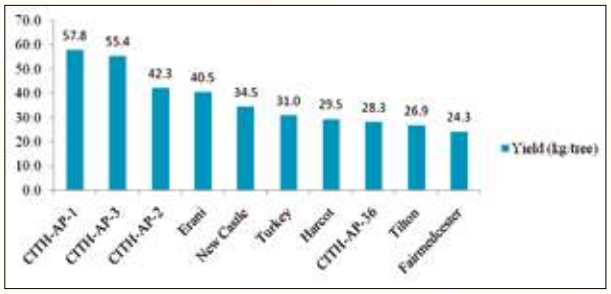


Fig. 2. Fruit yield of top ten apricot varieties/genotypes .

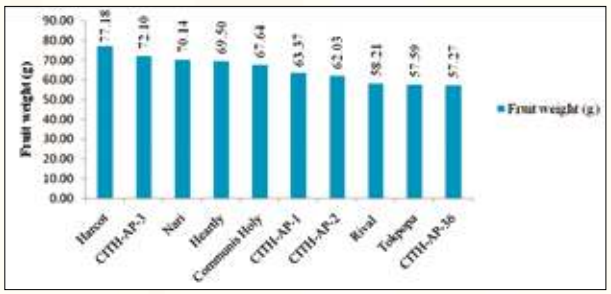


Fig. 3. Fruit weight among top ten apricot varieties/genotypes.

All the phenological stages were expressed in number of days before (-) or after (+) with reference cv. New Castle. Among the total 59 genotypes evaluated, 15 accessions were pre-selected and grouped into three categories early (05), main (06) and late season (04), based on the date of harvesting. Early season genotypes were found to be high yielding, with high fruit weight and lower TSS. Main season genotypes were 4-6 days late in flowering and 20-26 days late in maturity. The late season genotypes were 8-10 days late in flowering and 30-32 days late in maturity but shy bearing in nature. In different groups, CITH-AP-1, CITH-AP-2, CITH-AP-3, CITH-AP-4, Harcot, Erani, New Castle fall into early maturing and early flowering, while Rival, Titon, Communis Holly, CITH-AP-5, CITH-AP-9, CITH-AP-37 were in mid season flowering and main season maturing, and CITH-AP-24, CITH-AP-26, CITH-AP-31, Communis were in late flowering and late maturing group.Among the evaluated genotypes, all early maturing genotypes were high yielding, but yield fluctuation from year to year were more in these genotypes as they are more likely to be affected by early spring frost. Sweet kernel is one of the most desirable trait therefore the taste was also assessed and 45 genotypes were found with sweet kernel.

Oil content (%) of different commercial varieties/land races and indigenous genotypes was also assessed. Among commercial varieties, maximum oil content was found in New Castle (39.33 %) followed by Heartley (38.3 %). Among indigenous genotypes, maximum oil content was found in CITH-AP-7 (50. 25%) with bitter kernel followed by CITH-AP-24 (49.66%) and CITH-AP-13 (49.42%) both with sweet kernel.

Peach and Nectarine

Evaluation of peach (15) and nectarine (7) cultivars in respect of flowering, fruit shape, flesh colour, physico-chemical and yield parameter carried out in 2016-17 are presented in Table 8,9,10&11. Maximum fruit weight was recorded in Glo Haven (174.91g) and minimum was recorded in South Land P-2 (44.19g), the yield was highest in Red Globe (33.36 kg/tree) and lowest in South Land P-2 (9.60 kg/tree). In case of chemical traits, maximum TSS was recorded in July Elberta (16.16 ^{0}B) and minimum in Summer Glo (9.70 ^{0}B) and maximum ascorbic acid was recorded in Stark Early (6.63mg /100 ml fruit juice) and minimum was recorded in Elberta (3.42 mg/100 ml fruit juice).

In case of nectarine varietal evaluation of 4 years old plants the maximum fruit weight was recorded in Fantasia (89.25 g) and minimum in Snow Queen (46.07 g) and yield was highest in Fantasia (6.63 kg/tree) and lowest was in Vance Marble (2.97 kg/tree). However maximum TSS was recorded in May Fire (13.10 ^{0}B) and minimum was recorded in Snow Queen (9.23 ^{0}B) Maximum ascorbic acid was recorded in May Fire (5.65mg/ 100 ml fruit juice) and minimum was recorded in Fantasia (1.56 mg/100 ml fruit juice).

Glo Haven

Red Globe

Snow Queen

Vance Marble

Table 8. Yield and colour traits of different peach cultivars

Cultivars	Harvesting date	Yield/Plant	Colour			
			L	a	b	tint
K-209011	01-08-2016	15.32	62.93	14.07	32.56	-60.78
Stark early	25-07-2016	14.63	61.97	24.48	25.34	-73.15
Nimla	21-07-2016	17.73	51.20	26.04	20.41	-87.08
South Land P-2	29-07-2016	9.60	45.26	24.33	17.06	-84.68
Summer Glo	05-08-2016	13.83	63.69	17.13	35.60	-33.20
Glo Haven	12-08-2016	28.53	63.83	15.79	44.42	-67.83
Anna Rose	07-08-2016	11.23	63.13	26.46	36.31	-73.85
Red Globe	15-08-2016	33.36	60.97	19.98	19.56	-58.68
Peshawari	28-07-2016	19.06	66.45	16.77	26.66	-54.93
July Elberta	28-07-2016	19.46	60.69	23.91	27.51	-83.16
Kanto-5	04-08-2016	16.90	57.84	20.37	34.06	-75.43
Elberta	15-08-2017	21.23	63.01	18.29	28.51	-82.67
Quetta	02-08-2016	14.30	69.68	12.70	23.32	-36.19

Cultivars	Harvesting date	Yield/Plant	Colour			
			L	a	b	tint
Crest Haven	22-08-2016	27.43	47.92	25.21	16.78	-92.40
Red June	01-08-2016	18.76	60.21	22.93	22.72	-66.48
CD at 5%	-	*3.034*	*5.182*	*3.251*	*4.866*	*21.215*

Table 9. Physico-chemical characters of different peach cultivars

cultivars	Fruit weight (g)	Pulp weight (g)	Stone weight (g)	Pulp stone ratio	Fruit size (mm)	Fruit diameter (mm)	TSS (^{0}B)	Acidity (%)	Ascorbic acid /100ml Fruit juice
K-209011	57.53	53.05	4.483	11.80	52.73	45.47	11.96	0.85	3.92
Stark Early	80.34	74.94	5.407	13.89	55.45	53.98	13.28	0.72	6.63
Nimla	120.23	114.84	5.390	21.30	57.62	53.90	13.81	0.65	3.95
South Land P-2	44.19	41.64	2.557	16.29	40.32	42.66	13.81	0.65	4.46
Summer Glo	73.31	67.18	6.13	10.89	55.76	50.73	9.70	0.80	4.94
Glo Haven	174.91	168.56	6.343	26.57	66.79	71.37	13.30	0.93	5.16
Anna Rose	83.01	78.45	4.557	17.25	52.69	54.61	11.48	0.66	5.97
Red Globe	145.93	140.65	5.280	26.61	58.36	59.70	14.70	0.78	6.51
Peshawari	89.95	84.35	5.607	15.06	55.67	52.88	13.81	0.84	4.66
July Elberta	92.21	87.18	5.033	17.48	55.06	48.89	16.16	0.58	3.44
Kanto-5	78.10	73.55	4.550	16.13	53.19	51.71	14.35	0.79	3.72
Elberta	86.38	81.14	5.240	15.41	54.25	53.90	11.15	0.82	3.42
Quetta	107.78	102.48	5.313	19.32	57.55	56.94	10.85	0.78	3.87
Crest Haven	89.70	84.44	5.253	16.12	54.80	51.88	11.41	0.63	4.78
Red June	130.05	124.57	5.480	22.75	57.03	57.96	10.96	0.82	3.79
CD at 5%	*12.26*	*11.9*	*0.39*	*1.58*	*2.74*	*4.428*	*1.68*	*0.11*	*0.62*

Table 10. Yield and colour traits of different nectarine

Cultivars	Harvesting date	Yield/Plant	Colour			
			L	a	b	tint
Fantasia	27-08-2016	6.63	64.44	24.09	31.02	-105.82
Early Glo	16-07-2016	4.02	54.46	24.29	31.82	-89.12
Snow Queen	04-07-2016	5.63	52.84	26.27	30.18	-94.58
May Fire	22-07-2016	3.47	56.43	25.88	32.97	-82.74
Silver King	29-07-2016	3.50	55.81	33.55	26.89	-95.93
Vance Marble	15-08-2016	3.83	54.39	24.21	20.61	-92.78
Vance Missouri	18-08-2016	2.97	54.88	25.99	20.82	-91.38
CD at 5%	--	*1.53*	*4.38*	*3.13*	*5.14*	*7.22*

Table No 11. Evaluation of nectarine for various physico-chemical characters

Variety	Fruit weight (g)	Pulp weight (g)	Stone weight (g)	Pulp stone ratio	Fruit size (mm)	Fruit dia. (mm)	TSS (0 B)	Acidity (%)	Ascorbic acid/100g Fruit juice
Fantasia	89.25	84.66	4.59	18.48	57.33	55.10	11.77	0.97	1.56
Early Glo	62.01	57.51	4.50	12.75	51.53	49.68	10.80	0.90	4.84
Snow Queen	46.07	41.50	4.57	9.07	43.76	42.24	9.23	1.18	5.07
May Fire	75.97	70.88	5.09	13.95	55.22	55.20	13.10	1.05	5.65
Silver King	60.35	55.72	4.63	12.06	48.64	48.17	10.27	1.01	5.04
Vance Marble	84.23	79.61	4.62	17.51	56.88	54.93	12.23	1.01	4.21
Vance Missuri	84.63	79.60	5.03	15.80	56.87	55.63	12.33	0.97	4.31
CD at 5%	*7.98*	*7.90*	-	*2.224*	*2.26*	*2.92*	*1.92*	-	*0.44*

Plum

In plum, 22 cultivars (15 Japanese and 07 European plum) were evaluated for various physico-chemical parameters. In Japanese plum, maximum fruit weight was recorded in Mariposa (65.44 g) and minimum in Krassivica Plum (13.18 g) while maximum pulp stone ratio was noticed in Kanto-5 (64.53) and minimum in Methley (16.46). Maximum yield was recorded in Au-Cherry (28.00 kg/tree) and minimum in Krassivica Plum (4.76 kg/tree).

In case of European plum, maximum fruit weight was recorded in President Plum (67.33 g) and minimum in Italian Plum (28.31 g) however maximum pulp stone ratio was recorded in Kubio-26 (61.54) and minimum in Italian Plum (20.35). Maximum yield was recorded in President Plum (18.26 kg/tree) and minimum in Italian Plum (11.43 kg/tree).

Santa Rosa

Au-Rosa

Kanto-5

Au-Cherry

Fruiting in different plum cultivars

Almond

In almond, a total of 22 selections were evaluated for various traits. The CITH-Almond-9, CITH-Almond-11, CITH-Almond-14 and CITH-Almond-23 were found promising in respect of physical attributes of nut and kernel, nut yield and kernel recovery. Among the different selections CITH-Almond- 23, CITH-Almond-14 and CITH-Almond-17 have shown vigorous growth. In respect of kernel shape most of selections were found broad and intermediate except CITH-Almond- 4 and CITH-Almond- 7 which were extremely broad. Apart from CITH-Almond-4 (97.5%), CITH-Almond-20 (96.9%) and CITH-Almond-23 (95.5%), genotypes sound nut were obtained. Likewise with the exception of CITH-Almond-11 (24%) and CITH-Almond-9 (20%) in all other germplasm only 0- 3 per cent double kernel were observed. Twin kernel and gummosis infestation was not observed in any germplasm. Further, empty nut was only noticed in germplasm CITH-Almond-9 (2%). Merced and California Paper Shell were found promising in respect of physical attributes of nut, kernel and nut yield, whereas Shalimar, Non Pareil and Primorskij gave maximum kernel recovery among evaluated cultivars (Table 12&13 Fig .4&5)

Table: 12 Range for different nut, kernel and yield traits in almond selections

Parameters	Range	
Nut weight (g)	1.08 (CITH-A-21)	4.46 (CITH-A-11)
Nut length (mm)	23.13 (CITH-A-21)	30.04 (CITH-A-16)
Nut width (mm)	14.29 (CITH-A-21)	21.09 (CITH-A-2)
Nut thickness (mm)	12.16 (CITH-A-21)	16.45 (CITH-A-11)
Shell thickness (mm)	0.91 (CITH-A-21 and CITH-A-23)	2.55 (CITH-A-2)
Weight of 100 nuts (g)	120 (CITH-A-21)	374 (CITH-A-11)
Kernel weight (g)	0.47 (CITH-A-21)	1.45 (CITH-A-11)
Kernel length (mm)	16.7 (CITH-A-17)	22.56 (CITH-A-11)
Kernel width (mm)	9.64 (CITH-A-21)	13.4 (CITH-A-3)
Kernel thickness (mm)	6.54 (CITH-A-21)	9.49 (CITH-A-23)
Kernel width to length ratio	0.50 (CITH-A-19)	0.71 (CITH-A-4)
Kernel recovery (%)	26.3 (CITH-A-16)	36.0 (CITH-A-23)
Yield (kg/plant)	0.75 (CITH-A-21)	5.18 (CITH-A-9)
Yield efficiency (g cm^2tcsa)	7.23 (CITH-A-23)	58.92 (CITH-A-9)

Table 13 Nut, kernel and nut yield of different almond cultivars

Cultivar	Nut weight (g)	Nut length (mm)	Nut width (mm)	Nut thickness (mm)	Shell thickness (mm)	Kernel weight (g)	Kernel length (mm)	Kernel width (mm)	Kernel thickness (mm)	Kernel W/L ratio	Yield (kg/tree)	Est. Yield (q/ha)
Waris	2.24	34.21	21.26	14.03	1.48	1.47	26.03	14.63	7.00	0.56	1.872	11.700
Shalimar	2.01	31.14	15.15	13.17	0.67	0.96	21.92	10.22	6.25	0.47	1.158	7.238
Makhdoom	2.84	31.95	21.53	15.31	1.99	1.26	23.24	12.76	6.97	0.55	1.512	9.450
Merced	4.01	36.09	25.38	19.15	1.97	2.08	26.12	15.12	-	0.58	2.092	13.078
Pranyaj	2.96	40.50	24.24	15.66	1.08	1.91	27.83	14.09	7.83	0.51	1.700	10.626
Non-Pareil	1.78	34.82	19.31	12.40	0.84	1.12	24.77	12.60	6.28	0.51	1.120	7.004
IXL	2.99	33.55	19.90	15.56	2.08	1.48	26.64	13.47	8.15	0.51	1.288	8.050
Primorskij	3.16	44.56	22.88	15.17	0.98	1.89	30.66	14.08	6.87	0.46	1.324	8.276
CPS	3.31	47.25	21.15	15.56	2.38	1.34	30.67	11.66	7.05	0.38	2.098	13.114
CD at 5%	*0.468*	*1.832*	*1.265*	*1.011*	*0.279*	*0.173*	*1.818*	*1.008*	*0.558*	*0.039*	*0.401*	*2.506*

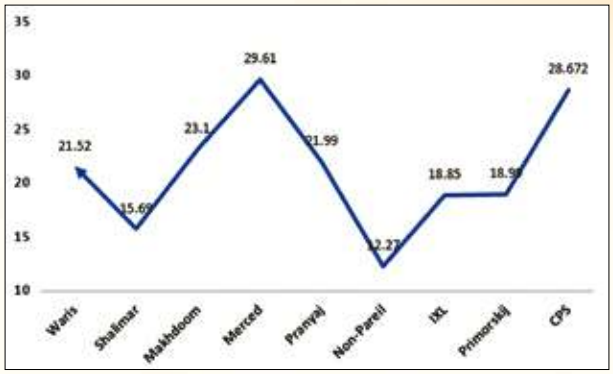


Fig. 4 Nut yield efficiency (g cm^2 tcsa) in different almond cultivars

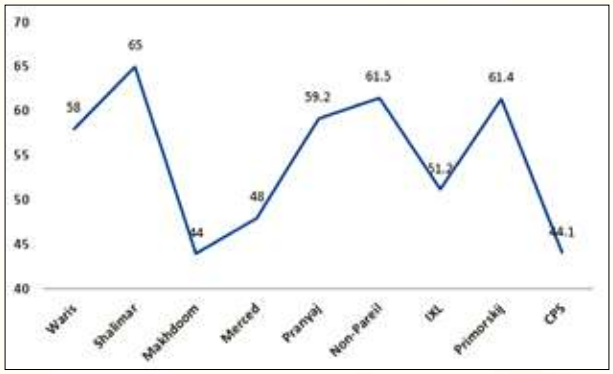


Fig. 5 Kernel recovery (%) in different almond cultivars

Walnut

In walnut, 136 accessions were evaluated and some trait specific walnut genotypes were identified among evaluated genotypes for parent selection in future breeding. CITH-W-35 (IC-587192) was found earliest in leafing and earliest in harvest and having dense branching and intermediate bearing habit. CITH-W-62(IC-587085) was ready for harvest one-two days after CITH-W-35. Genotypes CITH-W-18 (IC-587163), CITH-W-40 (IC-587287), CITH-W-48 (IC-617701), CITH-W-50 (IC-617703), CITH-W-54 (IC-617705), CITH-W-58 (IC-617707), CITH-W-59 (IC-617708), CITH-W-64 (IC-617710), CITH-W-71 (IC-617715), CITH-W-72 (IC-617716), CITH-W-120(IC-622835) were found with purple hull. Genotypes CITH-W-18, CITH-W-35, CITH-W-50, CITH-W-52 (IC-587092), CITH-W-54, CITH-W-58, CITH-W-59, CITH-W-64, CITH-W-71, CITH-W-72, CITH-W-95 (IC-587088), CITH-W-120 were found with intermediate bearing habit. Genotypes

CITH-W-11 (IC-587310), CITH-W-20 (IC-622809), CITH-W-80 (IC-617724), CITH-W-114 (IC-622832), Hamdan were found with very light shell colour. CITH-W-95 was found with light colored shell, light coloured kernel, easy for removal of kernel halves, dichotomous and with very dense branching with intermediate bearing habit but small nut size(11.40g).In last two years (2015 and 2016), genotype CITH-W-100 (IC-587268) showed consistently higher nut weight (22.30g, 22.32g) and kernel weight (10.6g, 11.02g). Among the evaluated genotypes, maximum nut weight (24.23g) and kernel (11.6 g) weight were recorded in genotypes CITH-W-7 (IC-561057) and CITH-W-118 (IC-587236) respectively. Highest shelling percentage was recorded in CITH-W-64 (60.19) followed by Hamdan (59.94%) and CITH-W-71 (58.73%). Minimum shell thickness was recorded in CITH-W-101 (IC-587271), CITH-W-106(IC-622827) and Serr (1.01 mm in each). Maximum nuts per tree were recorded in CITH-W-120 (1641) followed by CITH-W-95 (1095), CITH-W-68 (794) and CITH-W-121 (780). Highest yield efficiency (gcm^{-2} of tcsa) was recorded in CITH-W-95 (35.18) followed by CITH-W-14 (34.88), CITH-W-121 (26.37) and CITH-W-68 (24.08).

Besides, Institute released genotypes, CITH-W-62, CITH-W-114 and CITH-W-121 also seems to be promising for future based on their evaluation for various traits.

Bearing in CITH-W-35

Bearing in CITH-W-95

Bearing in CITH-W-1

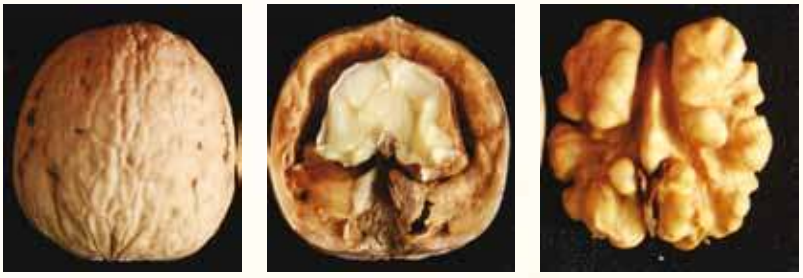
Heavy bearing walnut genotypes

Olive

In evaluation of 18 olive genotypes for important pomological traits (Table 14), the longest fruit was observed in genotype Cornicobra while shortest in Belice. Likewise the maximum fruit diameter was recorded in genotype Picholine and lowest in Cipressino which was found stastically *at par* with Etnea and Itrana. Fruit shape index was measured highest in genotype Cornicobra which was *at par* with Messenese and Cipressino however, lowest in Cerignola. The heaviest fruits were produced by Coratina which was *at par* with Toffohai and Tonda Ibea and lightest in Pendolino. Maximum oil content on fresh and dry weight basis was estimated in genotype Cipressino however, minimum in terms of fresh weight was recorded in Morolio and on dry weight basis in Ottobratica respectively. Firmest fruits were observed in Toffohai and lowest firm fruit was in Cerignola. Highest pulp weight was estimated in genotype Toffohai which was *at par* with Coratina however, lowest in Pendolino. Among stone characteristics maximum stone weight was observed in Picholine and lowest in Ottobratica whereas highest stone length was measured in Toffohai and lowest in Cipressino. Similarly highest stone diameter was noticed in Picholine and lowest in Messenese. Among all the genotypes, highest yield per plant was recorded in genotype Picholine and Cipressino and lowest in Morolio. The proportion of male and hermaphrodite flowers varied from cultivar to cultivar and location of shoot in the canopy.

Nut and kernel of CITH-W-62

Nut and kernel of CITH-W-114



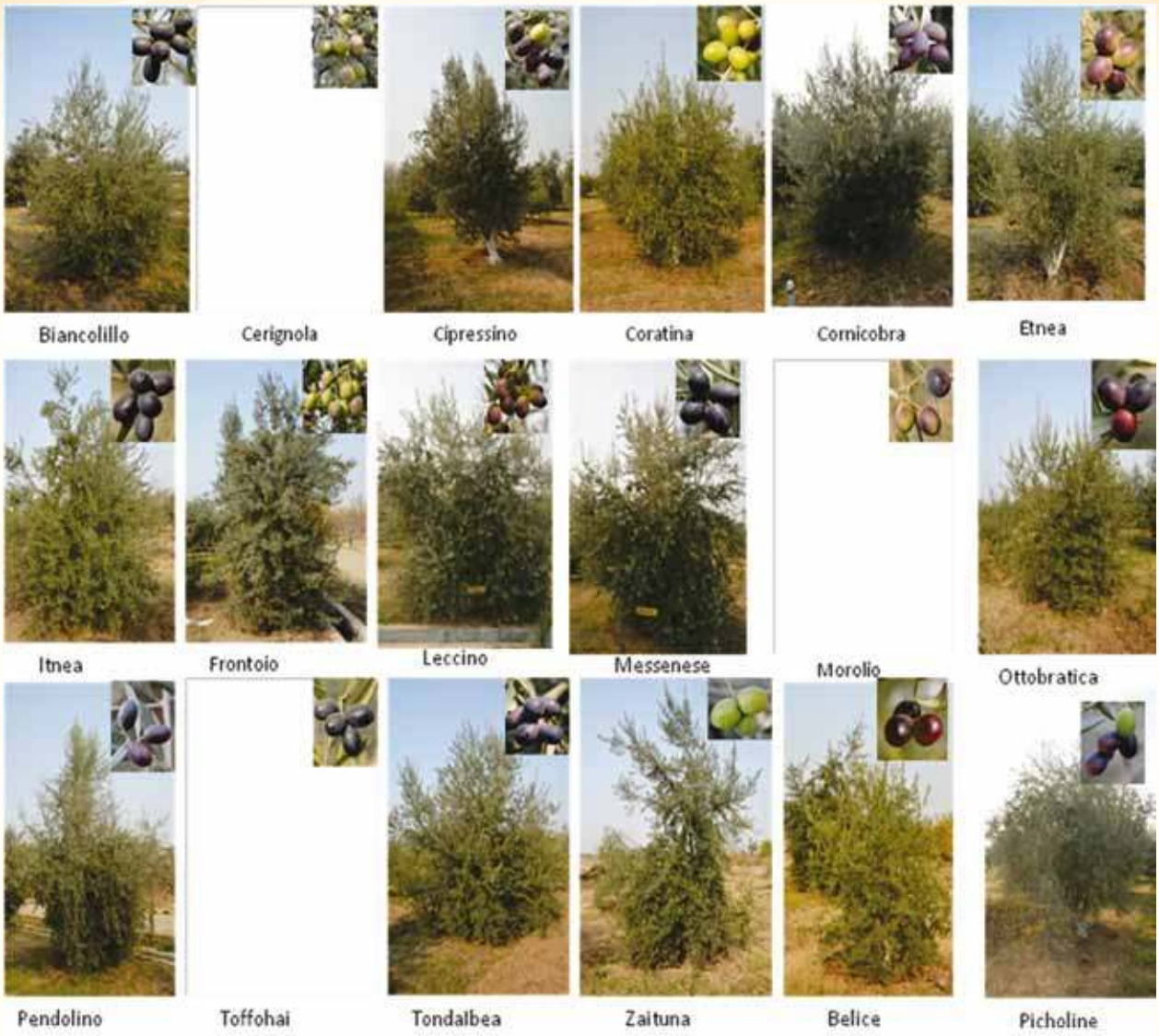
Nut and kernel of CITH-W-121

Nut and kernel quality of some best performing genotypes

Table 14. Fruit, oil and stone traits of various olive genotypes.

S. No.	Genotype	Fruit Length (mm)	Fruit Diameter (mm)	FSI	Fruit Weight (g)	Oil Content FW (%)	Oil Content DW (%)	Firmness index	Pulp Weight (g)	Stone Weight (g)	Stone Length (mm)	Stone Diameter (mm)	Yield (kg)
1	Ottobratica	20.48bdac	14.88bdc	1.38ebdac	3.28bdac	15.30ji	23.00l	9.21bc	2.77bac	0.52d	14.81bdc	8.14c	2.99
2	Morolio	22.23ba	16.19ba	1.37ebdac	3.51bac	14.40j	25.00kj	8.22ihgf	2.83bac	0.68bdc	15.35bac	7.77dc	0.40
3	Cornicobra	23.10a	14.64bdc	1.58a	3.51bac	17.24g	29.00i	8.92dc	2.89bac	0.62dc	14.92bdc	8.13c	2.65
4	Toffohai	20.54bdac	14.64bdc	1.40bdac	3.77a	19.89fe	30.00ih	9.80a	3.21a	0.55dc	16.90a	8.46bc	5.10
5	TondaIbea	20.56bdac	14.23dc	1.44bac	3.77a	16.20hi	24.00kl	8.32hgfe	3.08ba	0.69bdc	15.76ba	7.99dc	6.40
6	Biancolillo	20.69bdac	14.07dc	1.48ba	2.62ebdc	15.65hi	26.00j	7.88ihj	1.96edc	0.66bdc	15.02bac	8.02dc	5.33
7	Etnea	19.58bdc	13.32d	1.47ba	3.59ba	18.96f	31.00h	7.99ihgj	2.92bac	0.68bdc	13.80dc	7.74dc	3.70
8	Cerignola	18.67dc	15.81bac	1.18e	3.01ebdac	22.36ba	33.00g	7.54j	2.36ebdac	0.65bdc	15.54bac	7.93dc	8.05
9	Zaituna	22.22ba	16.14ba	1.38ebdac	3.54ba	20.31e	31.00h	9.56ba	2.98bac	0.55dc	15.43bac	9.05ba	11.50
10	Pendelino	21.21bac	14.26dc	1.49ba	2.17e	21.35dc	35.00ef	7.78ij	1.35e	0.82bac	16.13ba	8.16c	9.39
11	Messenese	21.66bac	14.08dc	1.54a	3.06ebdac	22.68ba	39.00b	8.45dgfe	2.22ebdac	0.84bac	15.18bac	7.34d	7.25
12	Cipressino	20.49bdac	13.26d	1.55a	2.30ed	23.34a	41.00a	8.76dce	1.39ed	0.92ba	13.05d	6.38e	16.90
13	Leccino	20.73bdac	16.13ba	1.28ebdc	2.40ed	22.50ba	32.99g	8.98dc	1.49ed	0.91ba	15.25bac	9.21ba	5.66
14	Picholine	20.88bdac	16.76a	1.24edc	2.50edc	21.78bc	38.00cb	9.11bc	1.46ed	1.05a	16.18ba	9.33a	16.87
15	Itrana	18.55dc	13.32d	1.39ebdac	3.18ebdac	17.42g	36.00ed	8.34hgfe	2.47bdac	0.71bdc	14.95bdc	8.16c	5.68
16	Frontoio	18.89dc	15.66bac	1.21ed	2.61ebdc	20.65de	37.00cd	8.23ihgfe	2.02ebdc	0.59dc	15.08bac	7.99dc	7.07
17	Coratina	21.71bac	15.32bac	1.41bdac	3.85a	19.89fe	34.00gf	8.56dfe	3.13a	0.72bdc	15.77ba	7.96dc	7.84
18	Belice	17.93d	14.12dc	1.27ebdc	2.89ebdac	16.54hg	26.00j	8.29ihgfe	2.20ebdac	0.69bdc	13.77dc	7.77dc	3.24
	LSD ($p \leq 0.05$)	*3.16*	*1.86*	*0.22*	*1.02*	*1.00*	*1.63*	*0.54*	*1.09*	*0.29*	*1.91*	*0.79*	--

Means in similar letters are not significantly different



Olive genotypes in bearing at ICAR-CITH, Srinagar

Kiwifruit

A total of five genotypes of kiwifruit were evaluated under pergola training system for various horticultural traits. Among fruit characteristics maximum fruit length was measured in Hayward followed by Monty, Allison and Abbott which were stastically *at par* however, shortest in Bruno. Similarly fruit width, fruit diameter and fruit weight was recorded maximum in Hayward and minimum in Bruno. No significant differences were observed among all the genotypes for fruit shape index whereas, maximum total soluble solids were recorded in Hayward which was found *at par* with Allison and minimum in Abbott. Highest titrable acidity was estimated in Abbott followed by Allison and lowest in Bruno which was stastically at *par* with Hayward and Monty. Sugar acid ratio was recorded maximum in Hayward followed by Bruno, Monty and Allison and minimum in Abbott. Maximum yield per plant (kg) was recorded in Hayward followed by Allison, Abbott and Monty and lowest in Bruno (Table 15).

Table 15: Physico-chemical and yeild attributes of different cultivars of kiwi fruit

Genotypes	Fruit Length (mm)	Fruit width (mm)	Fruit Diameter (mm)	FSI	Fruit weight (g)	TSS (°B)	Titrable acidity (%)	Yield (kg/plant)
Monty	46.05ba	31.79ba	35.88b	1.29a	28.16b	8.21ba	1.33b	23
Allison	42.23ba	31.53ba	33.84b	1.25a	29.23b	8.65a	1.39ba	30
Abbott	40.84ba	30.33b	32.59b	1.25a	22.54b	7.32b	1.51a	26
Hayward	49.55a	37.10a	44.72a	1.13a	50.47a	8.96a	1.36b	65
Bruno	37.24b	28.26b	29.38b	1.27a	20.63b	8.05ba	1.30b	8
LSD (p≤0.05)	*11.69*	*5.98*	*7.82*	*0.44*	*11.82*	*1.32*	*0.12*	--

Means in similar letters are not significantly different

Abbott

Allison

Monty

Hayward

Bruno

Fruiting in different cultivars of Kiwi Fruit at ICAR-CITH, Srinigar

Determination of maturity indices in Kiwi fruit

To optimize the harvesting date for best fresh quality and storability, the four genotypes of kiwifruit were harvested at different dates and critical quality parameters were recorded. Preliminary results showed significant change in fruit quality traits (TSS, titrable acid, TSS/acidity, ascorbic acid) among four kiwifruit genotypes (Hayward, Allison, Monty and Abbott) at different harvest dates. A significant increase in fruit TSS content was recorded as the harvesting progressed from the first harvest date to last harvest date in all four genotypes and could be considered as reliable maturity index. A steady decline in titrable acidity

content was noticed from first harvest date to last harvest date in all the genotypes. The significant increasing trend was observed in fruit TSS/ acid in all four kiwifruit genotypes as the harvesting advanced from the first harvest date to last harvest date. Ascorbic acid content in Hayward, Monty and Allison fruits increased up-to the 4th harvest date and declined gradually as the fruit advanced through maturity. Whereas in Abbott, ascorbic acid content increased up-to 3rd harvest date and thereafter, it declined gradually up-to last harvest date.The six-week duration of sampling in terms of days from full bloom to harvest in Hayward, Allison, Monty and Abbott were 177, 174, 178, 176 days. Results opined that Hayward had attained optimum maturity between 6th and 7th harvest dates and days from full bloom to harvest ranged between 170 to 177 days, (Allison 167, Monty 178 and Abbott 169-176 days).

Regional Station Mukteshwar, Uttarakhand

Apple

Evaluation of suitable apple cultivars in mid hill conditions of Uttarakhand

An experiment was conducted to evaluate the yield and physico-chemical characterstics of 18 apple cultivars belonging to Delicious group, spur type and colour strains. The highest fruit yield (46.11 kg/tree), fruit weight (217.33 g), fruit volume (231.67 cc), fruit length (6.98 cm) and fruit diameter (8.22 cm) were recorded in cultivar Spur Type Red Delicious. The lowest fruit yield (19.12 kg/tree) and fruit length (4.33 cm) were recorded in Chaubattia Anupam, while, lowest average fruit weight (64.67 g), fruit volume (63.33 cc) and fruit diameter (5.32 cm) were estimated in Gloster. The highest T.S.S. was recorded in Skyline Supreme (14.73 °B) while lowest in Chaubattia Princess (11.26 °B), whereas, highest acidity was recorded in Golden Delicious (0.66%) and lowest in Chaubattia Princess (0.14%). The cultivar Skyline Supreme gave highest values for ascorbic acid (8.25 mg/100 g), reducing sugar (9.62%), total sugars (12.42%), carotene content (235.73 µg/100 g) and total anti-oxidant activity (41.95 mMTE/L) while Prima exhibited lowest values of ascorbic acid (3.92 mg/100 g) and total sugar contents (6.15%). The lowest values for reducing sugar (5.13%), carotene content (79.45 µg/100 g) and total anti-oxidant activity (30.66 mMTE/L) were recorded in cultivar Gloster, Vermont Spur and Stark Spur, respectively. The cultivar Golden Delicious is the most luminous (L^*=84.86) and having the highest yellow colour (b^*=67.10) and hue angle (h°=87.41), whereas Chaubattia Anupam showed the highest red colour (a^*=54.15) and Chroma (C^*=67.53).


Chaubattia Anupam


Chaubattia Princess


Oregon Spur


Rich-A-Red


Red Chief


Starkrimson


Skyline Supreme


Spur type Red Delicicious

Fruits of different apple cultivars in mid hill conditions of Uttarakhand

Physico-chemical characteristics of apple germplasms collected from Kumaon hills of Uttarakhand

A survey was conducted in Kumaon hills of Uttarakhand for evaluation of physico-chemical characteristics in apple germplasm. During the survey, total 16 variants of apple were collected and assessed for their important physico-chemical traits. The highest fruit weight (304.37 g), fruit volume (300.00 cc), fruit length (8.08 cm) and fruit diameter (9.05 cm) were recorded in Collection-2, while the lowest fruit weight (103.87 g), fruit volume (106.67 cc), fruit length (5.51 cm) and fruit diameter (6.27 cm) were recorded in Collection-6. The highest specific gravity was recorded in Collection-9 (1.07 g/cc), while the lowest was recorded in Collection-1 (0.90 g/cc). The highest fruit firmness was recorded in Collection-5 (9.10 lb/inch^2), while lowest in Collection-11 (3.57 lb/inch^2). The highest T.S.S. (13.97 °B) was recorded in Collection-5, while lowest in Collection-13 (10.50 °B), whereas the highest acidity was recorded in Collection-10 (0.90%) and lowest in Collection-2 (0.28%). The highest ascorbic acid content was recorded in Collection-16 (10.42 mg/100 g), while lowest in Collection-6 (3.75 mg/100 g). The highest total sugars (10.39%), reducing sugars (9.23%) and total anti-oxidant activity (40.70 mMTE/L) was recorded in Collection-12, while lowest total sugars (5.92%) and reducing sugars (5.17%) was recorded in Collection-15. However, the lowest total anti-oxidant activity was recorded in Collection-11 (21.32 mMTE/L). The highest non-reducing sugar was recorded in Collection-13 (1.94%) and lowest in Collection-1 (0.56%). The highest carotene content was recorded in Collection-4 (137.31 µg/100 g) while the lowest in Collection-5 (60.17 µg/100 g). The Collection-1 is the most luminous (L^*=85.20), whereas Collection-12 is the least luminous (L^*=29.05). The highest red colour was recorded in Collection-2 (a^*=42.26), while lowest in Collection-8 (a^*=1.50). The highest yellow colour (b^*=68.25) and Chroma (C=68.89) was recorded in Collection-6, while lowest yellow colour (b^*=17.06) was recorded in Collection-12 (b^*=17.06). However the lowest Chroma (C=29.65) was recorded in Collection-10. The highest hue angle was recorded in Collection-8 (h°=91.40), while the lowest in Collection-12 (h°=26.46). The most of the physicochemical characteristics were found superior in Collection-2 and Collection-12 as compared to other apple collections.

Evaluation of different apple cultivars for shelf life

An experiment was conducted at ICAR-CITH, regional station, Mukteshwar, Uttarakhand on 10 apple cultivars to access their shelf-life at ambient storage condition. The cumulative physiological loss in weight, TSS, reducing sugar, total sugar and fruit decay percentage increased, while fruit firmness, acidity, ascorbic acid content and organoleptic score decreased on prolonging the storage period in all the cultivars. The cultivar Skyline Supreme exhibited minimum physiological loss than other apple cultivars. However, the cv. Red Chief exhibited highest ascorbic acid, reducing sugar and total sugar content and the cv. Bright-N-Early exhibited highest fruit firmness, lowest acidity and fruit decay as compared to other apple cultivars during 49 days of storage. Conclusively, Skyline Supreme, Red Chief and Bright-N-Early have better shelf-life than other apple cultivars under ambient storage conditions.

Bright-N-Early

Skyline Supreme

Red Chief

Shelf life evaluation of different apple cultivars

Plum

Variability in physico-chemical characteristics of plum genotypes collected from Kumaon hills of Uttarakhand

A survey was conducted in Kumaon hills of Uttarakhand for evaluation of physico-chemical characteristics in 12 plum genotypes. The physical characteristics of fruits were found superior in Collection-8. The highest T.S.S. (15.60 °B) and lowest acidity (0.90%) were recorded in Collection-5, while lowest T.S.S. (10.50 °B) and highest acidity (1.94%) were recorded in the Collection-12. The maximum ascorbic acid (13.33 mg/100 g) was recorded in Collection-1, while minimum ascorbic acid (5.42 mg/100 g)

Variability in plum genotypes collected from Kumaon hills of Uttarakhand

was recorded in Collection-6. The highest total sugars (7.63%), reducing sugars (5.44%) and carotene content (701.97 mg/100g) were recorded in Collection-2, while lowest total sugars (3.73%) and reducing sugars (2.13%) were recorded in the Collection-12. The maximum total anti-oxidant activity (37.35 mMTE/L) was recorded in Collection-3, while minimum total anti-oxidant activity (14.49 mMTE/L) was recorded in Collection-7. The most of the physico-chemical characteristics were found superior in Collection-8, Collection-2 and Collection-5.

Peach

An experiment was conducted at Nainital district of Uttarakhand for evaluation of physico-chemical characteristics in different peach cultivars. The physical characteristics of fruits were found superior in Red June and Paradelux. The highest TSS was recorded in Florda Sun (12.17 °B), while lowest in Red Nectarine (8.77 °B). The highest acidity was recorded in Asariya (1.21%), while lowest in Sharbati (0.49%). The highest ascorbic acid content was recorded in Red June (12.92 mg/100 g), while lowest in Paradelux (5.42 mg/100 g). Total sugars (4.16%) and reducing sugars (3.03%) were recorded highest in Florda Sun, while lowest total sugars (2.65%) and reducing sugars (1.85%) were recorded in Paradelux. The highest carotene content was recorded in Golden Monarch (584.98 µg/100 g), while lowest in Florda King (101.82 µg/100 g). The highest total anti-oxidant activity was recorded in Red June (34.63 mMTE/L), while lowest in Paradelux (20.87 mMTE/L). The most of the chemical characteristics of fruits were found superior in Red June and Florda Sun as compared to other peach cultivars (Table 17&18).


Red June


Florda King


Florda Sun


Fla-16-23


Sharbati


Reliance


Red Nectarine


Paradelux

Evaluation of suitable peach cultivars in mid hill conditions of Uttarakhand

Table 16: Physical characteristics of fruits of different peach cultivars

Cultivars	Fruit weight (g)	Fruit volume (cc)	Specific gravity (g/cc)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (lb/inch^2)	Pulp weight (g)	Seed weight (g)	Pulp: stone ratio
Red June	188.92	189.00	1.00	6.25	7.60	4.27	179.56	9.36	20.78
Florda King	64.96	65.00	1.00	4.75	4.93	4.03	60.67	4.29	15.68
Florda Sun	72.91	80.00	0.91	4.81	5.35	12.90	66.84	6.07	11.43
Fla-16-23	82.42	88.33	0.94	5.10	5.53	11.87	76.70	5.72	13.98
Sharbati	82.83	95.67	0.87	5.14	5.47	10.60	78.11	4.72	16.53
Golden Monarch	85.14	89.67	0.95	5.76	5.39	6.93	76.88	8.26	9.62
Reliance	93.83	96.67	0.98	5.90	5.82	5.67	88.99	4.85	18.40
Red Nectarine	147.56	153.67	0.96	5.87	6.20	4.97	139.53	8.03	17.69
Arkansas	139.06	148.33	0.94	6.06	6.02	2.73	131.88	7.18	18.54
Asariya	69.53	72.00	0.96	5.66	4.43	5.70	61.91	7.62	8.21
Paradelux	160.63	171.67	0.94	7.31	6.60	6.00	148.16	12.47	12.11
CD at 5%	*19.55*	*21.25*	*NS*	*0.52*	*0.50*	*4.36*	*18.88*	*2.85*	*6.86*

Table 17. Chemical characteristics of fruits of different peach cultivars

Cultivars	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100 g)	Total sugar (%)	Reducing sugar (%)	Non-Reducing sugar (%)	Total anti-oxidant activity (mMTE/L)	Carotene content (µg/100 g)
Red June	9.70	0.78	12.92	3.86	2.46	1.32	34.63	129.60
Florda King	12.07	0.84	6.67	3.81	2.46	1.28	34.05	101.82
Florda Sun	12.17	0.86	10.00	4.16	3.03	1.08	24.47	110.05
Fla-16-23	9.40	0.75	7.08	3.13	2.15	0.93	24.23	111.08
Sharbati	10.40	0.49	6.67	3.90	2.53	1.30	31.25	318.85
Golden Monarch	10.73	0.85	7.08	3.65	2.34	1.25	33.67	584.98
Reliance	9.90	0.77	6.67	3.91	2.51	1.32	34.11	457.18
Red Nectarine	8.77	0.64	6.25	3.11	2.12	0.94	27.96	170.74
Arkansas	9.97	0.50	7.08	3.43	2.58	0.81	31.96	316.02
Asariya	10.93	1.21	6.25	3.29	2.29	0.94	32.55	415.27
Paradelux	9.60	0.64	5.42	2.65	1.85	0.76	20.87	156.59
CD at 5%	*1.12*	*0.27*	*3.63*	*0.30*	*0.45*	*0.16*	*2.58*	*9.46*

Kiwifruit

During the year 2016, the yield and physico-chemical performance of five kiwifruit cultivars *viz*. Monty, Hayward, Allison, Bruno and Abbott was recorded. The highest fruit yield (70.28 kg/plant), fruit length (71.73 mm), fruit weight (61.66 g) and fruit volume (60.41 cc) were estimated in cultivar Allison. The lowest fruit yield (25.12 kg/tree) and fruit length (52.20 mm) were recorded in Hayward, while lowest fruit weight (53.84 g) and fruit volume (52.70 cc) was estimated in Monty. The fruit firmness was found highest (7.53 lb/in^2) in Hayward while the lowest (2.37 lb/in^2) in Monty. The highest T.S.S. (13.50 °B) was found in Allison while lowest (11.67 °B) in Abbott, whereas highest acidity (2.39%) was recorded in Monty and lowest (1.89%) in Abbott. The highest ascorbic acid (110.47 mg/100 g), carotene content (354.33 µg/100 g) and total anti-oxidant activity (37.04 mMTE/L) was recorded in Bruno while lowest ascorbic acid (89.52 mg/100 g) and total anti-oxidant activity (31.14 mMTE/L) was recorded in Hayward. The lowest carotene content (218.56 µg/100 g) was recorded in Monty. The highest reducing (7.04%) and total sugars (8.31%) was found in Monty while lowest reducing (4.56%) and total sugars (5.10%) in Hayward.

Another experiment was carried out to assess effect of different levels of fruit thinning on fruit characteristics of kiwifruit cultivars Allison and Hayward. The perusal of data revealed that the highest fruit weight (57.34 g in cv. Allison and 59.33 g in cv. Hayward), fruit length (60.41 mm in cv. Allison and 59.25 mm in cv. Hayward), fruit diameter (40.45 mm in cv. Allison and 41.87 mm in cv. Hayward), fruit volume (56.00 cc in cv. Allison and 57.33 cc in cv. Hayward) and fruit firmness (7.60 Ib/inch^2 in cv. Allison and 8.10 Ib/inch^2 in cv. Hayward was recorded in T_5 (50% fruit thinning) while these parameters were lowest under T_6 (control). In respect of chemical parameters, the highest T.S.S. (14.50 °B in cv. Allison and 15.40 °B in cv. Hayward), reducing sugar (6.58% in cv. Allison and 5.25% in cv. Hayward) and total sugar (7.22% in cv. Allison and 6.41% in cv. Hayward) was recorded in T_5 (50% fruit thinning). The maximum acidity (2.11% in cv. Allison and 2.21% in cv. Hayward) was recorded under T_1 (10% fruit

Monty

Hayward

Allison

Bruno

Abbott

Fruits of different kiwifruit cultivars evaluated in Kumaon hills of Uttarakhand

thinning) whereas, the minimum acidity (1.64%) in cv. Allison was recorded under T_5 (50% fruit thinning) while in cv. Hayward the lowest acidity (1.44%) was recorded in T_3 (30% fruit thinning). Maximum ascorbic acid (90.77 mg/100g) in cv. Allison was recorded under T_1 (10% fruit thinning) while in cv. Hayward the maximum ascorbic acid (91.92 mg/100g) was recorded in T_2 (20% fruit thinning). The maximum carotene (267.00 µg/100g) and antioxidant activity (39.88 mMTE/L) in cv. Allison was recorded under T_4 (40% fruit thinning) and T_5 (50% fruit thinning) respectively while in cv. Hayward the maximum carotene (294.00 µg/100g) and antioxidant activity (38.04 mMTE/L) was recorded under T_3 (30% fruit thinning) and T_2 (20% fruit thinning), respectively. From this study it can be inferred that 50% fruit thinning improves the fruit characteristics of kiwifruit cultivars Allison and Hayward.

Kainth (*Pyrus pashia* L.)

A survey was conducted in Kumaon hills of Uttarakhand for evaluation of genetic diversity in kainth (*Pyrus pashia*). During the survey, nine accessions of kainth were collected and studied for their important morphological traits. A considerable variability in morphological, fruiting and seed characteristics was observed among the accessions. Majority of the accessions are upright and spreading in growth habit, medium to large in size and less infected with diseases and insect pests. The leaf size ranged between 3.86-9.50 cm in length and 2.45-6.17 cm in width, the leaf petiole length ranged from 1.09-3.90 cm. The fruits are small to medium in size (1.45-3.60 cm in length and 1.61-4.62 cm in width), round in shape and light brown in colour. The fruit weight ranged from 2.88-48.82 g and having 7-15 °B TSS. The number of seeds/fruit ranged from 6.00 to 10.67, seed length 0.52 to 0.73 cm, seed width 0.31 to 0.60 cm, seed index 0.29 to 2.91 g and seed germination percentage 52.82% to 95.57%. The collector no. SKV/RRA/AK/1844 recorded the highest leaf size (9.50 cm length and 6.17 cm width), fruit size (3.60 cm length and 4.62 cm width), fruit peduncle length (2.60 cm), TSS (15 °B) and seed size (0.73 cm length and 0.60 cm width) as compared to the other accessions.

Vegetable crops

Kale

In kale a total of 56 genotypes including 5 checks were evaluated for various desirable traits.

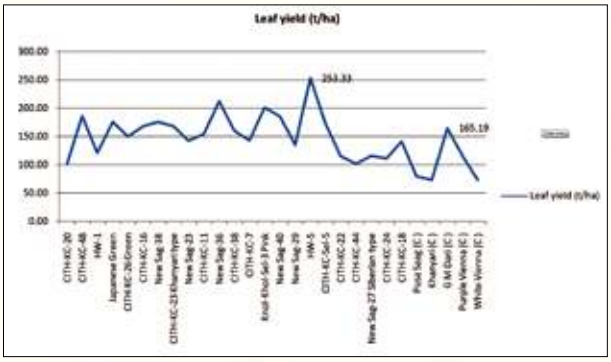


Fig 6: Trend of leaf yield obtained among the tested genotypes

Genetic Diversity in fruits of Kainth (*Pyrus pashia*) under Kumaon hills of Uttarakhand

Fruits of some Cherry tomato genotypes

The highest leaf yield was noted in HW-5 (253.33 t/ha) which was higher than the best check G M Dari (165.19 t/ha). The trend of leaf yield obtained among the tested germplasm is represented in Fig 6

Allium spp.

A total of 16 exotic collections of *Alliums* from Central Asia jointly collected by ICAR-IARI, New Delhi and ICAR-CITH, Srinagar were multiplied and initial evaluation for important bulb characters was done. The bulb polar diameter ranged from 2.25 to 4.02 cm while bulb equatorial diameter varied from 1.54 to 5.54 cm.The highest value for these traits were recorded in EC-862426. Some of the species were unique in plant architectire, bulb structure and flavor with respect to local *Alliums*.

Garlic

In garlic, one variety of garlic CITH-G-3 was notified for release for hill zone-1 by variety release committee of AINRPOG, DOGR, Rajgurunagar, Pune.

At Regional Station, Mukteshwar, 6 lines in cherry tomato, 5 in tomato, 8 in capsicum, 6 in garlic, 2 in onion, 2 in cucumber, 3 in bottle gourd, 1 in pumpkin, 2 in French bean and 2 in Ram karela were identified and selected; of which 2 lines of cherry tomato and 1 of French bean were included in AICRP (Veg,) trials.

Flower crops

Evaluation of different chrysanthemum cultivars in temperate conditions

Twenty seven cultivars were evaluated for various plant and floral traits during 2016. Significant differences were noticed for various traits among different cultivars. Maximum plant height (86.66 cm) was recorded in cultivar Baggi while plant girth (17.5 mm) and primary branches (8.0) in cultivar Punjab Anuradha. The leaf length (7.99 cm) and width (5.29 cm) were recorded in cultivar Dirty White. Cultivar Surf produced maximum number of secondary branches (9.33). Maximum number of flowers per bunch (20.33) were produced by cultivar Ajay while maximum number of flowers per plant (337.3) were recorded in cultivar Punjab Anuradha. Maximum flower length (29.47 mm) was recorded in cultivar R Venkat Raman while, flower width (94.38 mm), ray floret length (51.36mm) and width (12.73 mm) were recorded in cultivars President Vizer. Based on flower yield cultivars Punjab Anuradha, Pusa Sona, Ajay, Holiday Purple and Dirty White were found promising for temperate climate

Evaluation of different Lilium cultivars under polyhouse and open conditions.

Diiferent lilium cultivars were evaluated for various traits under polyhouse conditions (Pavia, Brunello, Brindsii and Litouwen) and

open conditions (Brunello, Litouwen, and Royal Trinity). Among different cultivars, variations were noticed for various traits like plant height, girth, number of leaves, leaf length, leaf width, leaf thickness, number of flower buds / plant, bud length, bud thickness , flower length, flower width and vase life. The significant differences were observed only for number of flowers /plant, bud length, flower width, leaf breadth and vase life. Based on flower yield, flower size and vase life cultvar Pavia was found best for polyhouse conditions. In open conditions, maximum growth was recorded in cultivar Litouwen followed by Royal Trinity. Maximum flower were produced by Cultivar Brunello and biggest flowers were produced by Litouwen.

Breeding for development of superior varieties/hybrids in Solanaceous crops

In the advanced varietal trials of chilli, sweet pepper and brinjal at Srinagar, two entries of chilli; CITH-HP-85/13 (18.51 t/ha) and Sel-136-1-2 (18.44 t/ha), three entries of sweet pepper; Nishat-1-Sel-2 (136.94 t/ha), Gold-Sel (31.86 t/ha) and SH-SP-4 (39.56 t/ha), and one entry of brinjal; B-4-9-Sel-1 (84.92 t/ha) performed significantly better than their respective local checks.

Fruiting in capsicum

At regional Station, Mukteshwar, 16 genotypes of tomato were evaluated during summer 2016 for their growth and yield parameters. Most of lines exhibited significant differences for various growth and yield parameters. Among the genotypes and hybrids, maximum number of fruits/plant (388.00) was recorded in CT-4 and minimum (20.66) in BT-210. However, highest average fruit yield/plant (3.236 kg) was recorded in VL-4 and lowest (0.496 kg) in CITH-M-CT-5. The variety VL-4 showed superiority in most of the traits viz., fruit breadth, fruit weight and fruit yield per plant under polyhouse conditions (Fig.7).

In capsicum, six genotypes were evaluated during summer 2016 at ICAR-CITH RS, Mukteshwar, Nainital (UK) for their growth and yield parameters. Most of the lines exhibited significant differences for growth and yield parameters under study. Among the genotypes average number of fruits/plant recorded maximum of 18.99 in CITH-Sel-4 and minimum of 5.50 in Orobelle. However, maximum average fruit yield/plant (1.626 kg) was found highest in CITH-Sel-2. Highest fruit yield/hectare was recorded in CITH-Sel-2 (1204.44 q/ha) and lowest in Orobelle 162.96 q/ha under polyhouse (Fig.8).

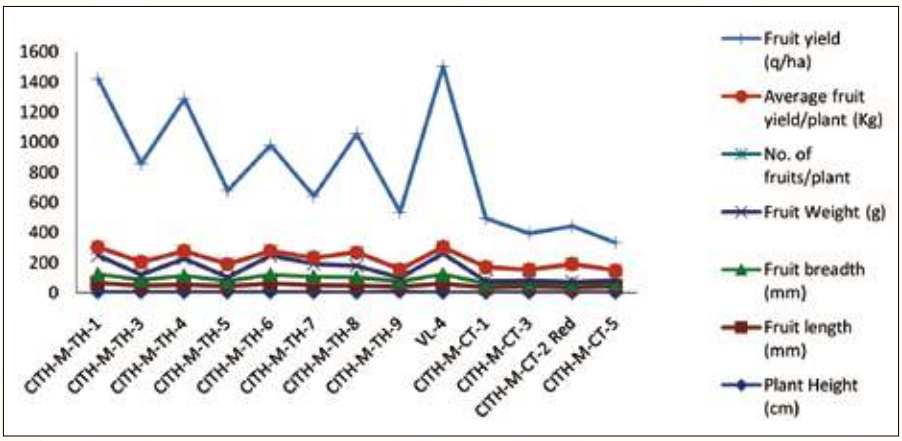


Fig 7: Performance of tomato genotypes under polyhouse

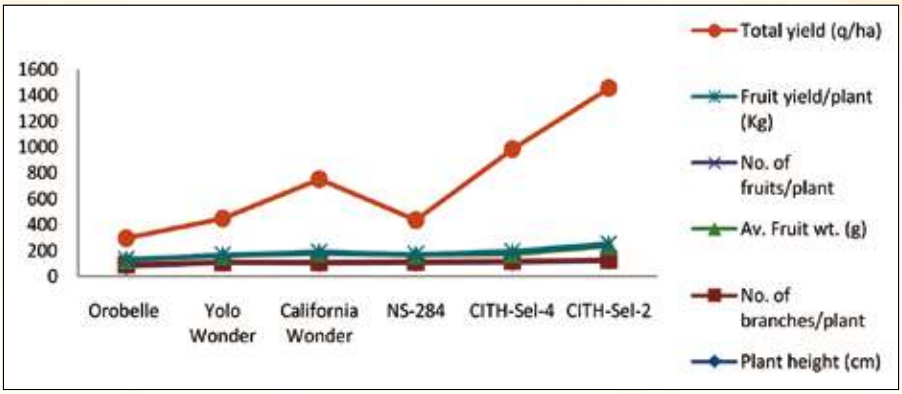


Fig 8: Varietal performance of capsicum

Development of superior cultivars in apple through conventional and non-conventional breeding methods

During the year 2016 four cross combinations using Prima as one parent were done to transfer the traits scab resistance from Prima to commercial apple cultivars. All the crosses showed significant fruit set and the seeds were sown for germination. Hybrid plants raised from earlier year's (2009-2015) crosses were evaluated and screened for scab, powdery mildew and aphid infection/infestation. At present seventy hybrids representing crosses of Ambri, Golden Delicious, Prima, Red Delicious, Royal Delicious, Top Red, Mollies Delicious, Granny Smith, Oregon Spur, Silver Spur, *M. floribunda*, Well Spur, Prima *etc.* contributed the traits like earliness, scab resistance, shelf life, fruit quality, regular bearing, fruit size, shape and low chilling have been established in the hybrid block. These hybrids are being top worked on MM-106 clonal root stock to obtain early fruiting for further evaluation. Hybrids top worked on MM-106 rootstock were evaluated for fruit quality traits and five hybrids *viz.* P1 (Red Delicious) x P2 (Mollies Delicious); P1 (Starkrimson) x P2 (Gold Spur); P1 (Golden Delicious) x P2 (Cooper-IV) ; P1 (Red Delicious) x P2 (Gala Mast) and P1 (Golden Delicious) x P2 (Red Fuji) were identified distinct from parents and with superior quality. These hybrids have been planted for establishment and large scale multiplication in CITH field gene bank.

S-allele typing of hybrids was done using specific primers to reveal the pollinizer potential of these hybrids. Golden Delicious generally regarding as universal pollinizer is having S-allele composition of S2, S3. Breeding objective for using Golden Delicious as one of the parent in crossing was to introgression of fruit quality genes in Golden Delicious cultivar or S-alleles from Golden Delicious to cultivars like Oregon Spur, Cooper-IV and Red Fuji. S-allele typing was used to identify and confirm the hybrids at molecular level (Table 18).

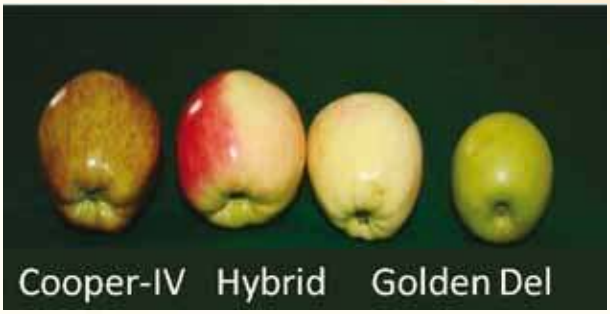
Five hybrids were evaluated for fruit quality traits and it was found that their quality vary with respect to parents. Fruit size of hybrid (Red Delicious x Mollies Delicious) was found higher (250 g) with respect to Red Delicious (197 g) and Mollies Delicious (200 g). Very significant variation in TSS was observed in hybrid Starkrimson x Gold Spur, hybrid showed higher TSS (18.2°Brix) which was higher than Starkrimson (15°Brix) and Gold Spur (16 °Brix). Higher TSS was also observed in Golden Delicious x Red Fuji hybrid (Table 19).

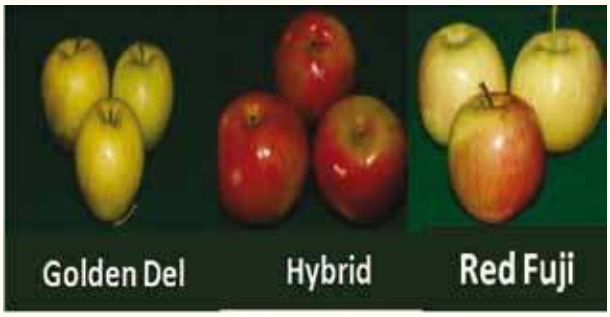
Table 18: S-allele typing in different parents and hybrids

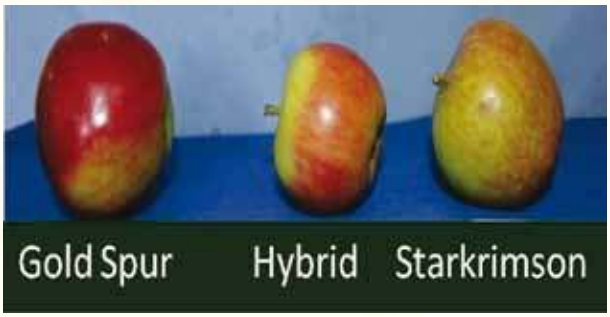
Parent 1 S-allele type	Parent 2 S-allele type	Hybrid S-allele type
Golden Delicious (S2,S3)	Oregon Spur (S6,S19)	Golden Delicious x Oregon Spur (S3,S19)
Cooper IV (S3,S7)	Golden Delicious (S2,S3)	Cooper IV x Golden Delicious (S3,S7)
Golden Delicious (S2,S3)	Red Fuji (S1,S24)	Golden Delicious x Red Fuji (S3,S24)
Red Delicious (S9,S8)	Mollies Delicious (S3,S7)	Red Delicious x Mollies Delicious (S9,S3)
Red Delicious (S9,S8)	Gala Mast (S2,S5)	Red Delicious x Gala Mast (S9,S2)
Ambri (S9,S2)	Mahariji (S6,S10)	Ambri x Maharaji (S2,S10)
Starkrimson (S7,S2)	Gold Spur (S3,S28)	Starkrimson x Gold Spur (S7,S3)

Table 19: Fruit quality hybrids top worked on MM-106 rootstock

S. No	Hybrid/Parent	Fruit weight (g)	Firmness (RI)	TSS (°Brix)
1	Red Delicious x Mol Delicious	250±3.2	73±2.4	14.2±1.2
	Red Delicious	197±1.3	80±2.6	16±2.1
	Mollies Delicious	200±1.8	52±1.4	14.6±2.0
2	Starkrimson x Gold Spur	105±4.2	54±1.3	18.2±0.5
	Starkrimson	103±1.7	46.2±1.2	15.2±1.6
	Gold Spur	120±2.4	48.4±2.8	16.2±2.0
3	Golden Delicious x Cooper-IV	190±5.6	68.2±2.2	15.7±1.2
	Golden Delicious	188±2.1	64.6±3.2	16.2±1.7
	Cooper-IV	220±3.2	92.0±3.2	14±2.0
4	Red Delicious x Gala Mast	95±2.1	75±1.8	17.2±1.7
	Red Delicious	197±4.2	80.8±4.2	16.0±1.8
	Gala Mast	125±1.6	60±1.6	15.6±2.1
5	Golden Delicious x Red Fuji	150±1.8	65±1.2	20.5±0.8
	Golden Delicious	190±2.2	68±1.6	16.4±1.2
	Red Fuji	152±1.7	42±1.3	18.8±2.1





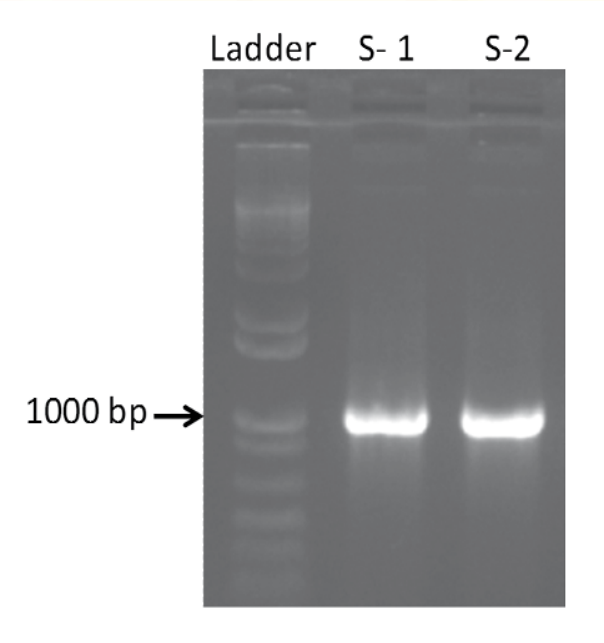


Variability in fruit parameters of hybrids with respective to their parents

Diagnosis and prognosis of apple viral diseases – Spatial and temporal variation in virus infection in apple

Seasonal variation of virus infection as detected by DAS-ELISA

Four season's spring, summer, autumn/fall and winter/dormant were used to study periodic detection of all the four viruses in different plant parts. The ACLSV was detectable in high concentration during spring and summer months in leaves, while in bark it is also detectable in both the seasons but in low concentration. ASPV and ASGV were detected in bark and leaf tissue during spring and summer while low detection was done in buds and flowers. Threat is that incidence of all the four viruses was in flower which is very alarming because if pollen will carry these viruses they can transmit these viruses to other plants. Although our studies reveal that pollen taken from infected planted did not show any serological reaction and thus were free from viruses but the our future programme will further study the incidence/presence of these viruses in pollen and seeds by using large number of biological replicates. Because both pollen and seed can transfer these viruses to healthy plants.



Amplification of partial sequence of *PdFLC* gene from genomic DNA samples

Characterization and diversity analysis for flowering related gene/ genes in almond

Genetic variation for dimensions of the floral parts among a group of almond genotypes revealed maximum stamen length in Shalimar while CITH A-22 reported shortest stamens. Longest stigmas

were observed in Pranyaj while California Paper Shell recorded the shortest stigma. Maximum petal length was recorded in Primorskij and Non-Pareil while, narrowest petals were observed in CITH-A-22 and California Paper Shell. Floral bud developmental studies among a set of 10 almond varieties and 23germplasm lines revealed earliest floral bud initiation in Shalimar and CITH A-23 while Drake was very late for initiation of floral bud. It was interesting to note rate of shift from one bud developmental stage to another was faster in Makhdoom compared to that in Shalimar. Gene sequences for *Apetala*, *FT* and *FLC* genes of several *Rosaceae* spp. were retrieved from NCBI and consensus motifs used for the design of primers. The primers designed against the Flowering Locus C gene amplified approx. 1 kb fragment from genomic DNA of Shalimar and Non-Pareil genotypes. The amplicon was PCR purified and sequenced. Sequenced fragment revealed homology with *FLC* gene of *P. persica*.

Phenotyping of almond germplasm for leaf fall and senescence revealed rapid senescence in CITH-A-4 and Makhdoom while IXL and Pranyaj were slow senescing genotypes. Another observation was that leaves of genotypes with small size tend to age slowly compared to those with larger leaves.In order to genotype the local almond genotypes for S-alleles, primers were designed and tested on the genomic DNA of local almond cultivars. Specific S-alleles were identified among these genotypes. These S-alleles can be used as molecular markers to distinguish almond cultivars.

Breeding for nutra-rich varieties/hybrids in root vegetable crops

In India main root crops are radish, carrot, turnip and beetroot. Radish, turnip and carrot are major root crops. All the above root crops are cool season crops and are highly cross pollinated. Genetic variation is essential for making selections in these root crops for nutritional rich germplasm or elite varieties. To achieve these objectives of root crops, different size, shape and colour of radish, carrot and turnips were selected to develop inbred lines while available inbred lines were sown simultaneous on the field. Both were selected on the horticultural phenotypic characters and made into stecklings. These stecklings were planted into polyhouse for attainment of crosses. Experiment was made under polyhouses to produce inbred seeds as well as hybridization in these root crops. The turnips selection for inbreds were Purple Globe, Purple Round, Pink Top White Globe, Pink Top White Round, Pink Top White Flat, Mustard Yellow, Pink Round, White Round, White Globe, White Flat, Pink Flat, Pink Globe, Golden Ball, Pusa Chandrima, Green Top White Flat, Green Top White Long, Green Top White Round, Green Top White Globe, White Round, Purple Flat, Golden Globe, Golden White Round, Golden Flat, Green Top, Purple Round Inner Purple, Red Round and Purple Flat while for radish inbreds were Pusa Himani, Pusa Chetki, Pusa Sagrika, Palam Selections. The different colours of carrots were selected in Ram Bagh areas of Srinagar such as black, orange and red whereas Pusa Asita, Pusa Meghali, Pusa Rudhira were also chosen for hybridization.

2. Crop production

The quality planting material is the most important component of temperate horticultural crops and output of a farm directly depend on it. The demand of planting material is increasing day by day. The ICAR-CITH is playing a significant role in production and supply of the quality planting material of temperate horticultural crops. During the year Institute has supplied about 21352 grafted/budded plants, 50802 scion woods of elite cultivars of temperate fruit crops while in vegetables 82.27 kg of vegetable seed were provided to farmers/ stakeholders. These planting material were provided/ sold for demonstrations to various agencies and farmers throughout the country.

Aquatic Dissipate/waste management through vermitechnology

To make best use of aquatic macrophytes, studies were taken and best proportion of aquatic macrophytes and worms was standardized. The amount of vermicompost prepared from aquatic macrophytes is presented in Fig. 9. The highest amount of vermicompost (9.22 and 9.36 kg) was prepared in the treatments where aquatic dissipate: worm ratio was 15:1 and 18:1 respectively. But the per cent bioconversion (Fig 10) of aquatic dissipate to vermicompost was maximum (76.83%) in the treatment where the ratio was 15:1. The vermicompost was analyzed for microbial population too (Table 20). The bacteria, fungi and actinomycetes in vermicompost were 211, 33.67 and 23.33 *10^8 CFU g^{-1} dry VC. Further the vermicompost was used to prepare nutrient rich dispersible vermiballs, bars and pellets.

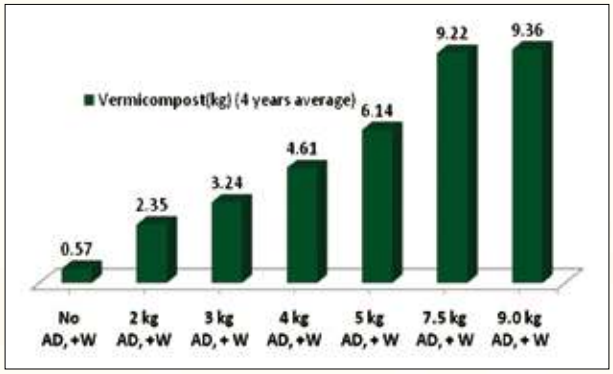


Fig 9. Vermicompost quantity as influenced by different proportions of aquatic dissipate (AD) and worms (W)

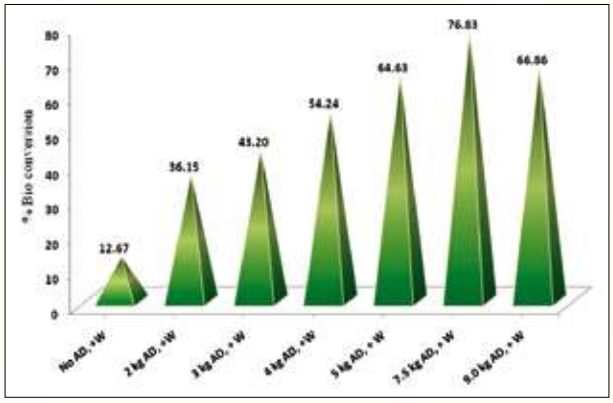


Fig 10. Per cent bioconversion of aquatic dissipate as influenced by different proportions of aquatic dissipate (AD) and worms (W)

Table 20. Microbial population of vermicompost (VC) prepared (15:1 ratio of AD:W)

S.No.	Microbes	Population	
		(*108 CFU g-1 dry VC)	(log 10*108CFU g-1 dry VC)
1.	Bacteria	211	2.32
2.	Actinomycetes	33.67	1.53
3.	Fungi	23.333	1.368

Enriched vermiballs, bars and pellets prepared from vermicompost obtained from aquatic dissipate

Divulging the adept mode of fertilizer application to optimize saffron yield

Adept mode of fertilizer application to get utmost saffron yield without polluting the environment was standardized. It was observed that highest saffron yield (Fig. 11) in case of small (CS1) as well as large (CS2) corm size was in the treatment where fertilizer was placed as midrib upper to corms in two splits (MRPU-2S). Besides yield, pollution potential of these modes (Table 21) was also studied and it was revealed that the afore mentioned treatment was not having any pollution potential as the nitrate leaching (Fig 12) in this treatment was well below the maximum

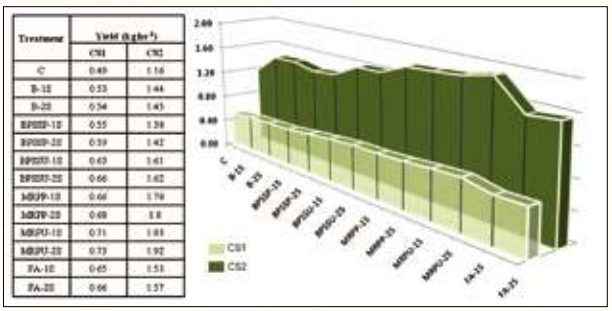


Fig. 11. Saffron yield as influenced by different modes of fertilizer application
(CS1: Small corm size; CS2: Large corm size)

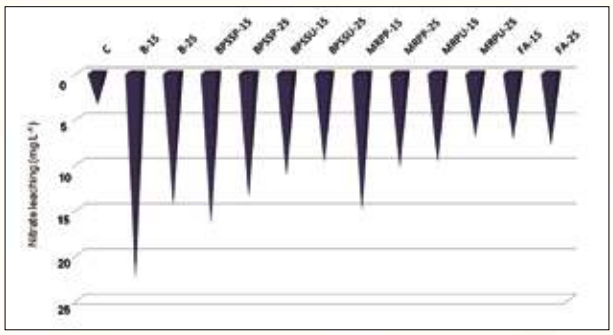


Fig. 12. Nitrate leaching (mg L^{-1}) as influenced by different modes of fertilizer application in saffron soils

Table 21. Pollution potential as influenced by various modes of fertilizer application

Treatment	Cumulative Pollution potential	Descriptions
C	-	Treatment descriptions: ***C**: Control (No nitrogen); **B-1S**: Broadcasting 'One split '; **B-2S**: Broadcasting 'Two splits'; **BPSSP-1S**: Band placement single sided parallel to corm (BPSSP) 'One split'; **BPSSP-2S**: Band placement single sided parallel to corm (BPSSP) 'Two splits'; **BPSSU-1S**: Band placement single sided upper to corm (BPSSU) 'One split'; **BPSSU-2S**: Band placement single sided upper to corm (BPSSU) 'Two splits'; **MRPP-1S**: Midrib placement parallel to corm (MRPP) 'One split'; **MRPP-2S**: Midrib placement parallel to corm (MRPP) 'Two splits'; **MRPU-1S**: Midrib placement upper to corm (MRPU) 'One split'; **MRPU-2S**: Midrib placement upper to corm (MRPU) 'Two splits'; **FA-1S**: Foliar application (FA) 'One split'; **FA-2S**: Foliar application (FA) 'Two splits* **Pollution potential descriptions** *Maximum permissible limit (MPL) of Nitrate in ground water = 10 mg L^{-1}* "-" *Negligible polluting potential (≤10 mg L^{-1})* "+" *Very less polluting potential (>10 ≤ 14 mg L^{-1})* "++" *High polluting potential (>14 ≤ 20 mg L^{-1})* "+++" *Very high polluting potential (>20 ≤ 30 mg L^{-1})* "++++" *Severe/very hazardous polluting potential (>30 mg L^{-1})*
B-1S	+++	
B-2S	+++	
BPSSP-1S	+++	
BPSSP-2S	++	
BPSSU-1S	++	
BPSSU-2S	++	
MRPP-1S	+++	
MRPP-2S	++	
MRPU-1S	+	
MRPU-2S	-	
FA-1S	-	
FA-2S	+	

permissible limit.

Fertigation: An efficient soil management stratagem for escalating nutrient and water use efficiency.

In order to optimize fertilizer use efficiency and to get optimum fruit yield various fertigation treatments were applied. Highest fruit yield as well as fertilizer use efficiency was observed in treatments where 75 per cent of recommended dose of fertilizer was applied through fertigation. The values of yield and fertilizer use efficiency in the said treatment was 33.90 t/ha (Fig 13) and 12.31 (Fig 14), respectively.

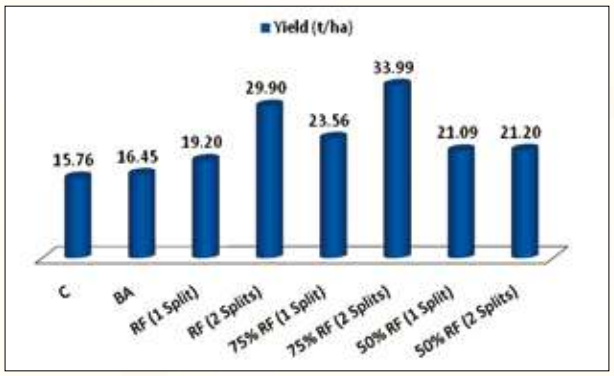


Fig 13. Apple yield as influenced by different fertigation treatments
(C: control; RF: recommended fertilizer)

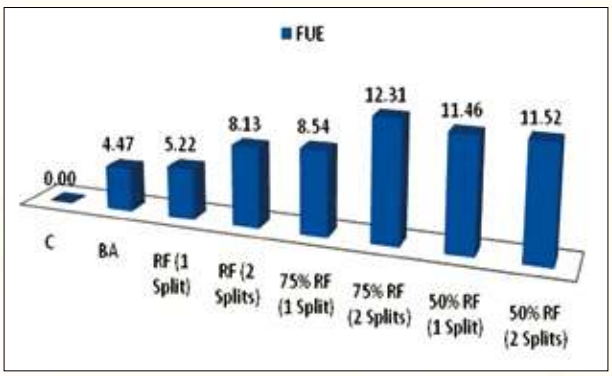


Fig 14. Fertilizer use efficiency as influenced by different fertigation treatments
(C: control; RF: recommended fertilizer)

Effect of various training and pruning systems in Persian walnut

To standardize the best training and pruning systems in walnut, 4 training systems, 7 thinning levels, 7 heading back levels and 7 thinning + heading back levels were tried and results obtained are briefly presented below:

Effect of various training systems in Persian walnut

The maximum nut efficiency (0.711 nuts/cm^2) was recorded in Open Center System, followed by Central leader (0.568 nuts/cm^2), modified central leader (0.491 nuts/cm^2) and multileader (0.437 nuts/cm^2) system. Among various training systems, differences were recorded for most of nut, foliage and floral traits. Maximum nut weight, height and thickness were recorded in walnuts trained on multi leader system and minimum shell thickness was recorded in open center system. Similarly maximum leaf length, terminal leaflet length and rachis length were recorded in central leader system. The leaf width, terminal leaflet width, upper leaflet length, lower leaflet length, lower leaflet width and rachis thickness were maximum in multileader system while upper leaflet width, middle leaflet length and middle leaflet width were found maximum in modified central leader system.

Effect of different levels of thinning in Persian walnut

In thinning experiment, significant differences were recorded in nut efficiency compared to control. Maximum nut efficiency (1.78 nuts/cm^2) was recorded in 20 per cent thinning at alternate years. Similarly 20 per cent thinning in alternate years proved to be best for increasing nut and kernel size. Maximum fruit weight, width, height and kernel weight were recorded in 20 per cent thinning in alternate years. Similarly, differences among various treatments were also observed for various foliage and floral traits.

Effect of different levels of heading back in Persian walnut.

All the heading back treatments improved most of the nut traits over control. Maximum nut efficiency (0.81 nuts/cm^2) was recorded at 30 per cent heading back level regularly. Maximum nut weight was recorded in 10 per cent heading back regularly while kernel weight was recorded in 20 per cent heading back in alternate years. Increase and decrease in size of various leaflets over control was noticed depending upon level of heading back

Effect of different levels of thinning + heading back in Persian walnut

In combined effect of thinning + heading back, maximum nut efficiency (1.08 nuts/cm^2) was recorded in 10 + 10 per cent thinning + heading back. Differences were recorded among various treatments compared to control for various nut and kernel traits. The treatment 20 + 20 per cent thinning + heading back in alternate years improved nut weight while kernel weight was found maximum in 30 + 30 per cent level of thinning + heading back. The considerable effect of various treatments was noticed among leaf and leaflet traits.

Development of almond based inter cropping system involving saffron

In almond based-saffron intercropping system, non significant effects were observed for majority of growth and floral traits in saffron. However, maximum saffron yield (5.99 kg/ha) was recorded in saffron + semi erect almond cultivars, followed by saffron + erect type of almond cultivars (5.98 kg), saffron + spreading almond cultivars (5.24 kg/ha) and saffron sole (2.35 kg/ha). Maximum almond yield (442.91 kg/ha) was recorded in saffron + spreading type of cultivars followed by saffron + semi-spreading type of cultivars (316.67 kg/ha) and saffron + erect type of cultivars (202.29 kg). Maximum saffron equivalent yield (6.31 kg/ha) was recorded in saffron + semi erect type of cultivars. In estimation of apocarotenoid content of saffron under almond cultivars having varying growth habits. Chemical analysis of saffron was carried out through HPLC. The highest percentage of crocin (3.2%) and safranal (0.03%) was recorded in S1 intercropping system i.e. sole followed by intercropping system S2 (erect) wherein the percentage of crocin (3.18%) and

saffranal (0.03) was found to be slightly lower than S1. Apocarotenoid percentage was found to be similar in S3 (semi-erect) and S4 (spreading) i.e. for crocin (2.8%) in both the systems and saffranal (0.02%) and (0.018%) respectively. As there is less effect on various traits, so the saffron + almond intercropping system especially with erect and semi erect type of cultivars can be successfully adopted in saffron fields to get additional income and can be helpful to save the farmers from losses of one crop.

Enhancing feathering through plant growth regulators for high quality nursery production in apple.

Feathered nursery plants are a critical component of high density apple planting system as use of feathered plant result in significant improvement in yield of new orchards over first 5 years. Therefore the aim of work was to standardize feather inducing techniques in apple using different plant growth regulators to boost Indian high density apple industry. The first objective of this project was assessment of effectiveness of two chemical containing the phytohormone, cytokinin (6-benzyladenine) alone and in combination with gibberellic acid (GA_3) applied at different concentration on feathering of one-year-old Oregon Spur and Gala Mast apple grafted on MM 106 rootstock. Total 12 treatments of benzyladenine (T_1- 200, T_2 300, T_3-400, T_4-500, T_5-600 and T_6-700 ppm) and benzyladenine plus gibberellic acid (T_7- 200, T_8 300, T_9-400, T_{10}-500, T_{11}-600 and T_{12}-700 ppm) along with control were used for feather induction. All treatment of plant growth regulators increased number of feather, feather length, branching zone and per cent feathered plants compared to control. The unsprayed trees of Oregon Spur/MM-106 had an average of 0.15 useful feathers per tree, 0.76 m total feather length and 4.0 cm branching zone. Three application of BA (500 ppm) at weekly interval resulted in more than forty times increase in the number of feathers (6.1), more than twofold increase in total length of feathers (1.61 m), fourfold increase in branching zone (20.09 cm). Further this treatment resulted in 100 per cent feathered plants compared to none feathered tree in control. Three application of BA (700 ppm) and BA plus GA_3 (700 ppm) at weekly interval also resulted in significant increase in feathering and 100 per cent feathered plants were observed in these treatments (Fig.15). The unsprayed trees of Gala Mast/MM-106 had an average of 1.85 useful feathers per tree, 1.17 m total feather length, 6.2 cm branching zone and 35 per cent feather plants. Three application of BA (700 ppm) at weekly interval resulted in more than fourfold increase in the number of feathers (7.75), more than twofold increase in total length of feathers (2.46 m), more than six fold increase in branching zone (38.67 cm) and threefold increase in per cent feathered plants (100 %). Three applications of BA (500ppm), BA (600ppm) and BA plus GA_3 (600 ppm), BA plus GA_3 (700 ppm) at weekly interval also resulted in an increase in feathering and 100 per cent feathered plants were obtained from all these treatments (Fig. 16).

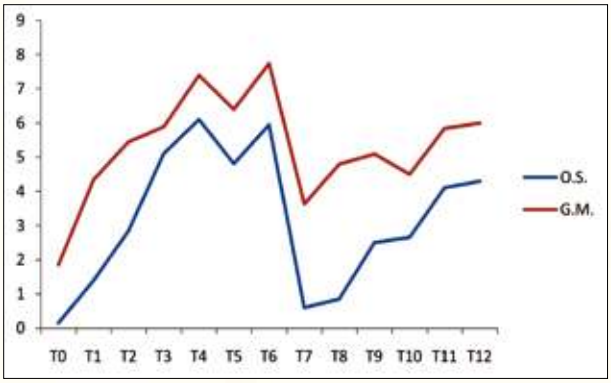


Fig. 15. Effect of varying doses of BA and BA plus GA3 on total number of feathers in Oregon Spur and Gala Mast apple.

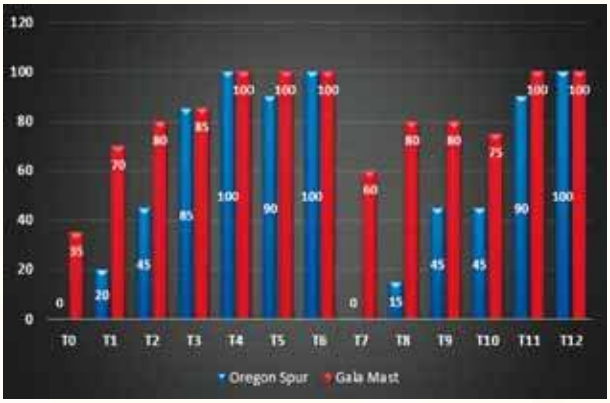


Fig. 16. Effect of varying doses of BA and BA plus GA3 on feathered plants (per cent) on Oregon Spur and Gala Mast apple.

Evaluation of different substrates and systems for soilless strawberry production (*Fragaria x ananassa* Duch.)

To standardize the substrate for soilless strawberry production, two cultivars i.e. Chandler and Katrian Sweet were planted during November, 2016 by using 16 treatment combinations involving cocopeat, perlite and vermiculite in different proportions. As per the data recorded maximum shoot length, length of petiole, crown diameter and number of leaves/plant has been recorded in cv. Chandler of strawberry with the treatment S_9 (cocopeat + vermiculite 50:50), followed by S_8 (cocopeat + vermiculite 25:75). In case of cv. Katrain Sweet maximum shoot length, length of petiole, crown diameter and number of leaves/plant has been recorded in the treatment S_{10} (cocopeat + vermiculite 75:25), followed by S_9 (cocopeat + vermiculite 50:50).

Standardization of growing/nutrients media and growing conditions for cost effective production of quality vegetables and their seedlings

This study was carried out at CITH, RS, Mukteshwar to standardize the media for raising seedling of different vegetables like tomato, capsicum, cucumber, lettuce, Chinese cabbage, broccoli and further evaluation of these seedlings for growth as well as for yield traits. The media used were soil, farm yard manure (FYM), vermicompost (VC), forest litter (FL) which were tried alone or in combination and total 12 treatments were used. In tomato cv. VL-4, various treatment exhibited significant differences for most of the seedling characteristics except number of leaves/seedlings and seedling root length. The maximum seedling length (25.33 cm) was recorded from treatment combination FYM + FL. However, number of secondary roots, fresh and dry weight of seedlings and seed germination percentage recorded maximum in soil + vermicompost treatment combination (Fig. 17). The significant differences were observed in the treatments for various growth and yield traits. Highest fruit yield of 4.60 kg/plant was recorded from the plants from which seedlings were raised on FYM medium. No definite trend was observed and no treatment exhibited superiority in more than one trait. Different treatments exhibited highest value for different traits (Fig. 18)

In capsicum cv. California Wonder, the seedling growing media exhibited significant differences for various seedling characteristics

Chandler

Katrain Sweet

Growth of strawberry cultivars in different media

of capsicum except root length and number of secondary roots/seedling. The seedling raised on FYM medium recorded highest values for seedling length (16.53 cm) and girth (2.94 mm), whereas for other parameters, no treatment showed superiority for more than one seedling trait. Most of treatment showed significant differences for the seedlings traits of capsicum under study. Highest fruit yield (1.84 kg/plant) was obtained from the plant of which seedlings raised on FYM medium, however, treatments had non-significant differences for this trait.

In cucumber, treatments showed significant differences for most of seedling characteristics of cucumber except seedling girth and seed germination percentage. Maximum seedling length (19.50 cm), number of leaves/seedling (7.00), fresh and dry weight of seedling were recorded in treatment combination of Soil + FYM + VC (1:1:1). Treatments responded significantly for most of the traits except number of fruits/plant. The plants of seedlings which were raised on Soil + FYM + FL (1:1:1) and FYM + VC + FL (1:1:1) exhibited superiority for two traits separately *viz.*, fruit length, fruit width and average fruit weight, fruit yield/plant, respectively.

In lettuce cv. Ice Berg, various treatments exhibited significant differences for seedling characteristics of lettuce. Seedling length (10.86 cm) and number of leaves/seedling (8.33) were observed maximum in the seedlings raised on soil medium. However, other parameters recorded highest values in different treatments.

In Chinese cabbage cv. Solan Band Sarson, significant differences were observed in the treatments for all the seedling characteristics of Chinese cabbage. Seedlings raised on FYM medium recorded highest values for seedling length (17.57 cm), seedling root length (9.10 cm) and seedling raised on VC + FL (1:1) recorded highest values for seedling girth (2.95 mm), number of leaves/seedling (8.00), fresh and dry weight of seedling (7.87 g & 0.65 g, respectively) as well as seed germination (100 %). Similarly in Broccoli cv KTS-1, all treatments showed significant differences for most of the seedling traits except number of leaves/seedling and fresh weight of seedling. Seedling raised on Soil + FYM (1:1) medium recorded highest values for seedling length (16.57 cm), seedling girth (2.58 mm) and number of leaves/seedling (6.00).

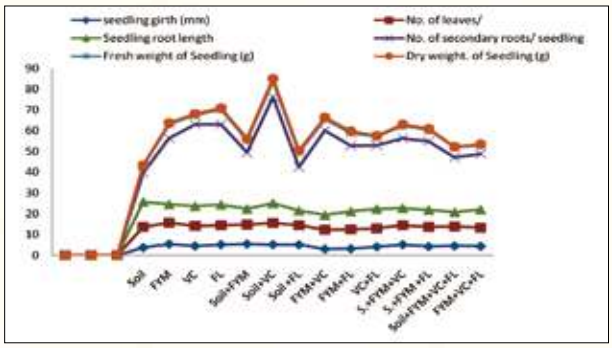


Fig. 17 Tomato seedlings characteristics under different media

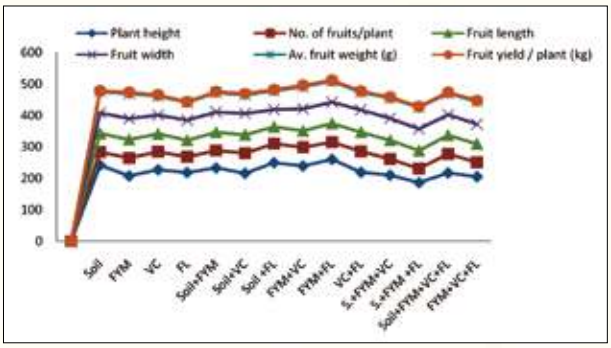


Fig 18. Growth and yield traits of tomato seedlings raised under different

Seedlings of different vegetable crops raised in various media

Tomato cv. VL- 4 plants of which seedlings raised in different medium

Cucumber trial visited by the Hon'ble Secretary (DARE) & Director General (ICAR)

Cucumber trial visited by the Director ICAR-CITH, Srinagar

Crop diversification technology for round the year vegetable production under protected conditions in mid and high hills of Uttarakhand

Many hilly regions of the country have emerged as off season producer of vegetable crops. To assess the suitability of various cultivars of different crops for round the year production,14 cv. of tomato,12 cv. of capsicum, 3 cv. of cucumber were tried at high hills and mid hills (Fig. 19, 20, 21, 22, 23 & 24).

In tomato, all genotypes exhibited significant differences for all the traits of study. Among the genotypes, VL-4 cultivar recorded highest values for fruit length (56.66 mm), fruit girth (69.69 mm), average fruit weight (81.61 g) and average fruit yield/plant (3.475 kg). However, plant height number of fruits/plant were found maximum in cv. S-2 and hybrid SH-TH-2, respectively in high hills under polyhouse

In another trial on tomato at Pokhrad, significant differences were observed among most of the genotypes for all the traits. Highest of 4.42 kg. fruit yield/plant was recorded in CITH-M-T-5, however, maximum number of fruits/plant (56.03) and average fruit weight (107.5 g) were observed in SH-TH-2 and CITH-M-T-3, respectively in mid hill conditions (Pokhrad) under polyhouse

In capsicum at high hills (Mukteshwar), all genotypes exhibited significant differences for the traits under study. Among the genotype, Yamuna hybrid recorded highest fruit yield of 1.55 kg/plant. However, highest average fruit weight and maximum number of fruits i.e. 125.4 g and 25.2 were recorded in Orobelle and Solan Bharpur, respectively in high hills under polyhouse. In another trial in mid hills, significant differences were exhibited by the genotypes for the traits under study. The highest average fruit weight (114.2 g), average fruit yield (1.9 kg/plant), fruit yield per hectare (1407.4 q) and maximum number of branches per plant (6.33) were recorded in Orobelle in mid hill conditions under polyhouse, whereas maximum number of fruits per plant was found in hybrid Lucky Star.

In cucumber, the hybrid Malini exhibited highest fruit weight (317.1 g), fruit yield per plant (2.8 kg) and fruit length (21.03 cm), whereas number of branches/plant (4.5), fruit girth (20.16 cm), vine length (5.72 m) and number of fruits/plant (10.16) were recorded maximum in Pusa Sanyog.

Among the four genotypes, Japanese Long Green exhibited highest fruit yield/plant (7.94 kg) as well as highest fruit weight (503.5 g) and fruit length (37.03 cm), however, Pusa Sanyog recorded maximum values for vine length (5.41 m) and number of branches/plant (10.66), whereas, fruit diameter was found maximum in Nazia (16.20 cm).

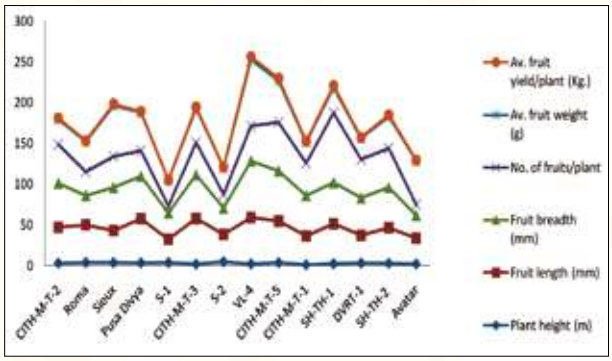


Fig. 19. Varietal performance of tomato in High hill under polyhouse

Tomato trial at Mukteshwar (High hills)

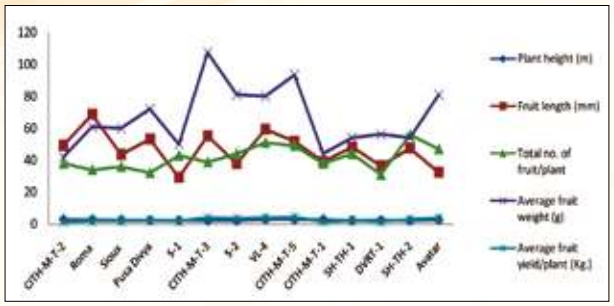


Fig 20. Varietal performance of tomato in Mid hill under polyhouse

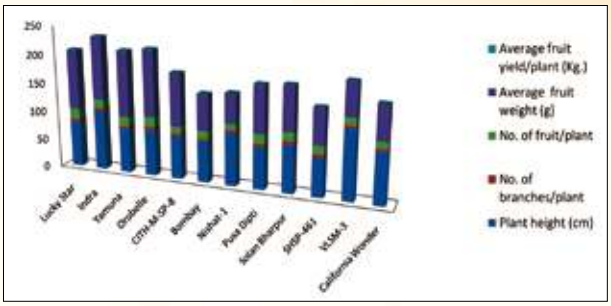


Fig. 22. Varietal performance of Capsicum in Mid hill under polyhouse

Tomato trail at Pokhrad (Mid hills)

Capsicum trial at Pokhrad (Mid hill)

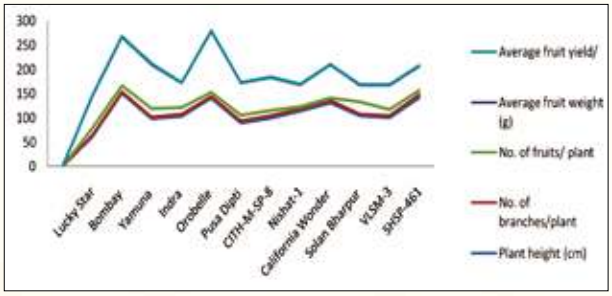


Fig. 21. Varietal performance of Capsicum in High hill under polyhouse

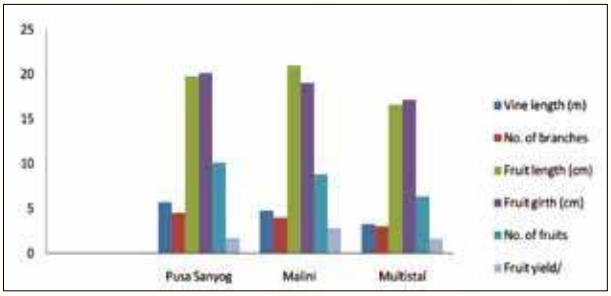


Fig. 23. Varietal Performance of cucumber in High hills under poly house

Capsicum trial at Muketshwar (High hills)

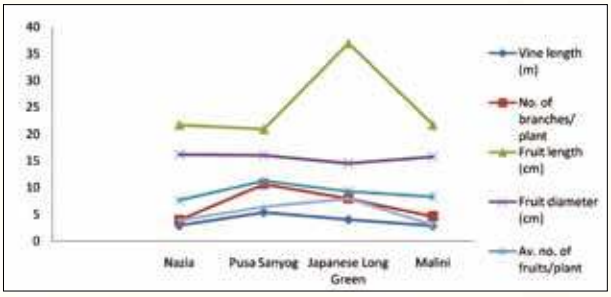


Fig. 24. Varietal Performance of cucumber in Mid hill under poly house

Standardization of integrated nutrient management of vegetables as intercrop in apple orchard.

Pea and cauliflower were intercropped with apple orchard along with four different treatment combinations comprising FYM + inorganic (Recommended dose), FYM + vermicompost + inorganic, FYM + vermicompost + biofertilizers + inorganic and FYM + inorganic (half of the recommended doses). Data on effect of intercropping on fruit quality *i.e.* fruit length, fruit diameter, fruit weight, fruit firmness and yield of apple were recorded. In both the intercrops treatment comprising FYM + vermicompost + biofertilizers + inorganic registered highest fruit length, fruit diameter, fruit weight, fruit firmness and yield of apple per tree as compared to other treatments (Table 22 and 23). This treatment also improved the fruit quality like TSS. Data on effect of Integrated Nutrient Management (INM) on different growth parameters of intercrops such as plant height, number of leaves, curd diameter, curd weight and yield in cauliflower; and plant height, number of branches, pod length and yield in pea were recorded. From the recorded data, the treatment comprising of FYM + vermicompost + biofertilizers + inorganic was found best in both pea and cauliflower intercrops in apple orchard exhibiting highest growth and yield followed by FYM + vermicompost + inorganic treatment (Table 24 and 25).

Intercropping of cauliflower cv. Snow Crown in apple orchard

Intercropping of pea cv. VL-7 in apple orchard

Table 22. Effect of INM and cauliflower as intercrop on fruit quality and yield of apple

Treatments	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit firmness (lb/in²)	Fruit TSS (⁰Brix)	Yield (kg/tree)
Apple sole	56.43	65.75	141.21	9.10	10.06	29.48
FYM + inorganic (Recommended)	56.41	65.67	141.26	9.11	10.63	28.73
FYM + Vermi + inorganic	57.24	67.82	144.35	10.36	11.53	31.63
FYM + Vermi + biofertilizer + inorganic	60.37	68.99	145.71	11.35	12.56	35.47
FYM + inorganic (half of the inorganic)	55.45	66.32	140.19	9.70	10.21	28.41
CD 5%	*NS*	*NS*	*NS*	*NS*	*0.99*	*NS*

Table 23. Effect of INM and pea as intercrop on fruit quality and yield of apple

Treatments	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit firmness (lb/inch²)	Fruit TSS (⁰Brix)	Yield (kg/tree)
Apple sole	58.30	67.09	144.68	8.62	11.49	31.91
FYM + inorganic (Recommended)	58.52	66.89	143.96	8.59	12.06	31.05
FYM + Vermi + inorganic	61.55	68.17	145.85	9.38	12.49	33.55
FYM + Vermi + biofertilizer + inorganic	64.43	70.92	147.59	10.64	13.42	37.93
FYM + inorganic (half of the recommended doses)	57.31	65.30	141.46	8.04	10.37	30.59
CD 5%	*3.66*	*NS*	*NS*	*1.29*	*NS*	*4.17*

Table 24. Effect of INM on growth and yield of cauliflower as intercrop under apple orchard

Treatment	Apple with Cauliflower as intercrop				
	Plant height (cm)	No. of leaves/plant	Curd diameter (cm)	Curd weight (g)	Yield (q/ha)
FYM + inorganic (Recommended)	40.36	13.66	15.38	365.33	128.72
FYM + Vermi + inorganic	41.45	15.16	16.40	476.33	137.05
FYM + Vermi + biofertilizer + inorganic	42.28	16.20	17.85	508.33	151.79
FYM + inorganic (half of the recommended doses)	39.30	13.23	14.57	341.33	105.72
CD at 5%	*NS*	*NS*	*1.99*	*NS*	*23.86*

Table 25. Effect of INM on growth and yield of pea as intercrop under apple orchard

Treatment	Apple with pea as intercrop			
	Plant height (cm)	No. of branches/plant	Pod length (cm)	Yield (q/ha)
FYM + inorganic (Recommended)	76.15	10.75	8.61	34.79
FYM + Vermi + inorganic	76.39	11.71	8.63	48.70

Treatment	Apple with pea as intercrop			
	Plant height (cm)	No. of branches/plant	Pod length (cm)	Yield (q/ha)
FYM + Vermi + biofertilizer + inorganic	78.48	12.73	9.44	52.16
FYM + inorganic (half of the recommended doses)	71.35	10.14	8.10	31.29
CD at 5%	*4.15*	*1.74*	*NS*	*8.59*

Characterization of soil and nutritional survey in apple and peach growing areas of Uttarakhand

Apple and peach growing soils of Uttarakhand were analyzed for revealing their important soil properties. At the sampling point, a 1×1 m soil profile was dug out at a depth of 60 cm and soil samples were collected from four different depths *viz*. 0-25 and 25-50 cm. The soil was analyzed for organic carbon and available N, available P, Some of the findings are given in the following subsections.

Soil organic carbon

The SOC values of the soil samples collected from different orchards of apple and peach is represented in Fig. 25. The SOC level of the peach orchards at Talla Ramgarh and Nathuakhan was very high in surface (0-25 cm) as well as subsurface soil (25-50 cm). There was also significant difference in C contents between the soil depths in the peach orchards. However, the apple orchards at Bhadgaon and Chilianaulla showed very low level of SOC in subsurface soil. Further, SOC contents did not vary significantly between the soil depths at these two orchards. In contrast, the apple orchard at Chaubatia showed high and significant SOC levels in both the soil depths.

Available phosphorus

Available phosphorus contents of the soil samples collected from different orchards of apple and peach is represented in Fig. 26. Available phosphorus content of the soils ranged from high to very high in different orchards. Highest level of available P was observed at the peach orchard of Nathuakhan. Except apple orchards at Chilianaulla and Chaubatia, there was significant difference in available P contents between the soil depths. Available P content was more in subsurface than surface soil at the apple orchard of Chaubatia. Like SOC, available phosphorus level also decreased as soil depth increased.

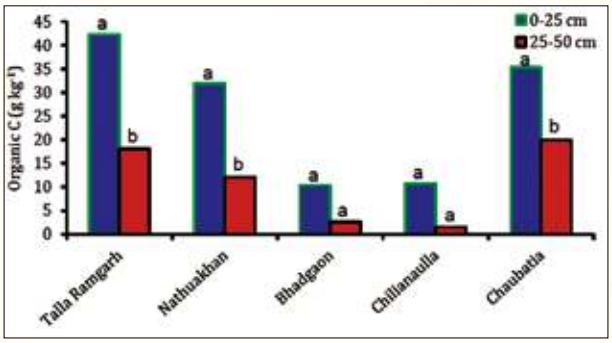


Fig. 25. Soil organic C contents of soils collected from different orchards of apple and peach. Bars followed by letter in common within a site do not differ significantly at p< 0.05 based on Duncan's multiple range test (DMRT).

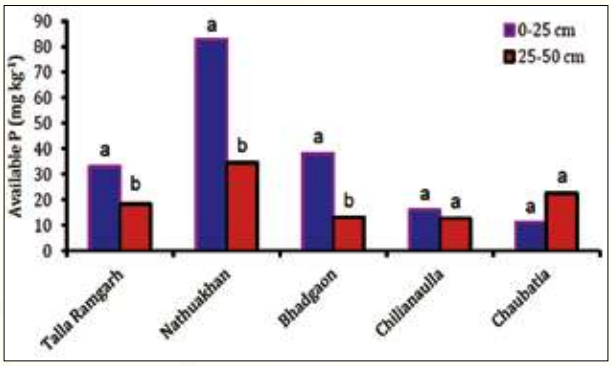


Fig. 26. Available P contents of soils collected from different orchards of apple and peach. Bars followed by letter in common within a site do not differ significantly at p< 0.05 based on Duncan's multiple range test (DMRT).

3. Crop Protection

Development of spray schedule against major canker and foliar diseases of apple in Uttarakhand

Influence of different weather parameters on the development of major canker and foliar diseases of apple in Nainital district of Uttrakhand

An experiment was carried out to visualize the effect of different weather parameters on the development of major canker and foliar diseases of apple in Nainital district of Uttrakhand. Observations on the severity of apple diseases were made at monthly intervals w.e.f. 1st January, 2016 to 30th September, 2016. In case of apple crop, host-pathogen interaction was greatly influenced by the weather parameters which make the control of diseases often very difficult. Relative humidity showed significant effect on the severity of major canker and foliar diseases of apple. None of the canker diseases were noticed between the month of January, 2016 to May, 2016. As per the observations, this period remained dry and comparatively less humid (42 to 57% relative humidity). Two foliar diseases *viz.*, Marssonina blotch (r=0.805) and powdery mildew (r=0.846) exhibited highly significant correlation with relative humidity. Besides this, powdery mildew disease also exhibited highly significant correlation (r=0.805) with minimum temperature. The coefficient of multiple determination (R^2) was calculated as 0.767 to 0.917 for major canker and foliar diseases of apple which signifies that 76.70 to 91.70 per cent variation in percent severity of major canker and foliar diseases during the period under report dependent on weather parameters included in these studies (Fig.27,28 and Table 26)

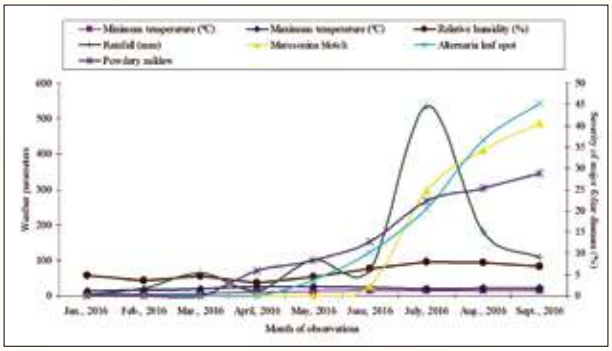


Fig 27: Effect of weather parameters on the development of major foliar diseases of apple in Nainital district of Uttrakhand.

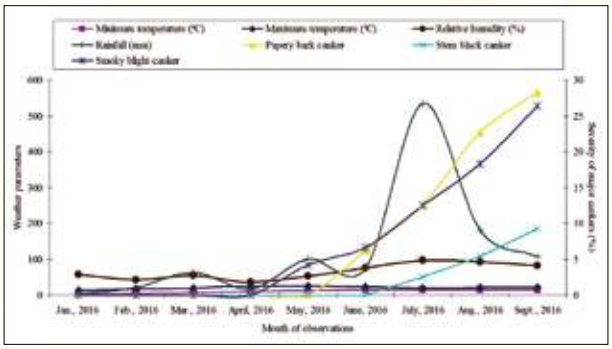


Fig 28: Effect of weather parameters on the development of major canker diseases of apple in Nainital district of Uttrakhand

Table 26: Simple correlation between weather parameters and severity of major canker and foliar of apple in Nainital district of Uttrakhand- 2016

Parameter	Simple correlation coefficient					
	Canker diseases			Foliar diseases		
	Papery bark	Stem black	Smoky blight	Marssonina blight	Alternaria leaf spot	Powdery mildew
Minimum temperature (^{0}C)	0.599	0.467	0.653	0.577	0.622	0.805**
Maximum temperature (^{0}C)	0.189	0.131	0.255	0.134	0.221	0.393
Relative humidity (%)	0.796*	0.649	0.793*	0.805**	0.797*	0.846**
Rainfall (mm)	0.402	0.282	0.433	0.516	0.408	0.588

*Where; *- Correlation is significant, **- Correlation is highly significant*

Management of major soil born diseases of apple

Influence of edaphic factors on mortality of apple plants caused by white root rot of apple

To visualize the relationship between percent mortality of apple plants by white root rot of apple and edaphic factors *viz*., soil temperature and soil moisture; observations on percent mortality of grafted plants of apple were recorded at monthly intervals in apple nursery of ICAR-Central Institute of Temperate Horticulture, Regional Station, Mukteshwar, Nainital Uttarakhand, starting from 1st June to 31st December, 2016. Occurrence and the development of white root rot of (*Dematophora necatrix*) apple were greatly influenced by the soil moisture and temperature. Both these parameters showed positive correlation with mortality of apple plants by this disease (Fig. 29). In this respect, soil moisture exhibited highly significant correlation (r=0.956). The coefficient of multiple determination (R^2) was calculated as 0.916 for percent mortality of apple plants by white root rot of apple which signifies that 91.60 percent variation in percent mortality of apple plants dependent on edaphic factors included in these studies. It is apparent from the value of R^2 (0.916) that besides the mentioned two edaphic factors other parameters of diseases development like pathogen virulence, host susceptibility etc are also playing key role in causing mortality of apple plants. Mortality of apple plants by white root rot disease progressed rapidly during the month of July where, average soil temperature of 20.67°C and soil moisture of 1.22 g/kg soil was recorded. It was observed that there was a definite relationship between percent mortality of apple by *Dematophora necatrix viz a viz* soil temperature and soil moisture.

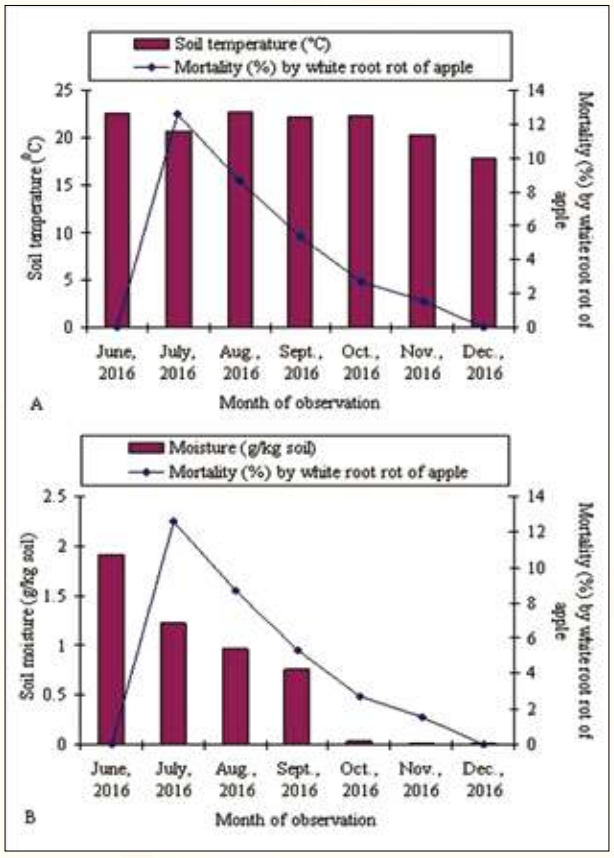


Fig 29: Effect of different edaphic factors viz., soil temperature (A), and soil moisture (B) on mortality of apple plants caused by white root rot of apple (Dematophora necatrix).

Above ground symptoms of white root rot of apple (*Dematophora necatrix*)

Below ground symptoms of white root rot of apple (*Dematophora necatrix*) on the advance stage of infection

4. Post Harvest Technology

Studies on dried prunes in relation to cultivars and drying technology

Plums are perishable fruit and difficult to be transported for longer distance, thus offers a great scope for value addition. In current study the effect of cultivars and drying technology in plum was investigated. Before dehydration of plum for prunes initial quality analysis was taken for fruit weight, fruit firmness, TSS, acidity, ascorbic acid and chromatic value. Three cultivars *i.e.* Grand Duke, President Plum and Italian Prune (pitted material) were taken for drying for prune. Two drying modes were undertaken *i.e.* Osmo dehydration followed by dehydration in cabinet dryer dried at 60° C and direct cabinet drying at 60° C . Among the cultivars for osmo dehydration Italian Prune took minimum time (3 hrs 15 min) for dehydration by osmosis followed by President Plum (3 hrs 45 min) and Grand Duke (4 hrs and 20 minutes). Over all dehydration by means of osmo dehydration followed by cabinet drying at 60° C, minimum time was taken by Italian Plum (11 hrs 45 min). After 180 days of storage at low temperature (4° C), maximum colour (L, a and b), ascorbic acid retention was recorded in Italian plum when osmo dehydrated. Over all study reveals that Italian Plum took less time for dehydration and retained colour and ascorbic acid in addition to relatively higher rehydration ratio (Table 27, 28 & Fig 30, 31, 32). Organoleptic evaluation further confirms the results.

Italian plum

Osmo dehydrated Italian plum

Table 27: Fruit quality characteristics of plum cultivars (processed for prunes)

Cultivars	Av. Fruit Wt. (g)	Fruit Firmness (RI)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/100g)	color		
						L*	a*	b*
Italian Plum	33.3	41.88	8.3	0.27	16.5	31.1	8.1	-1.50
Grand Duke	66.5	38.32	9.7	0.21	14.9	38.90	13.1	21.15
President Plum	68.0	39.82	8.6	0.24	13.5	30.0	14.3	-0.16

Table 28: Time taken for dehydration by different cultivars and drying methods.

Cultivars	Drying method	Time taken for drying
Italian Prune	Osmo+ Cabinet drying	3 hrs 15 min + 8 hrs 30 min.
	Cabinet drying	10 hrs 20 min
President Plum	Osmo+ Cabinet drying	3 hrs 45 mins. + 9 hrs20 min
	Cabinet drying	11hrs 30 min.
Grand Duke	Osmo+ Cabinet drying	4 hrs 20 min + 10 hrs 20 min.
	Cabinet drying	10 hrs. 55 mins.

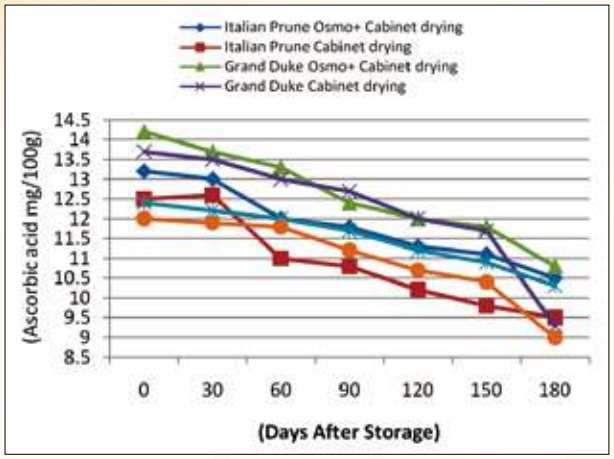


Fig 30: Changes in ascorbic acid content during different storage period in different plum cultivars

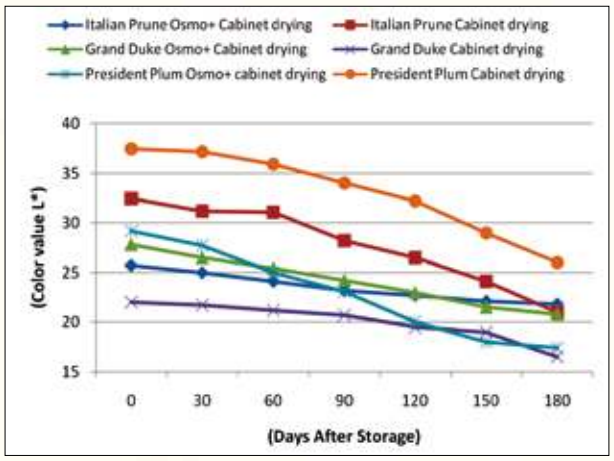


Fig 31:Colour (L*) retention in different cultivars and drying methods during storage period

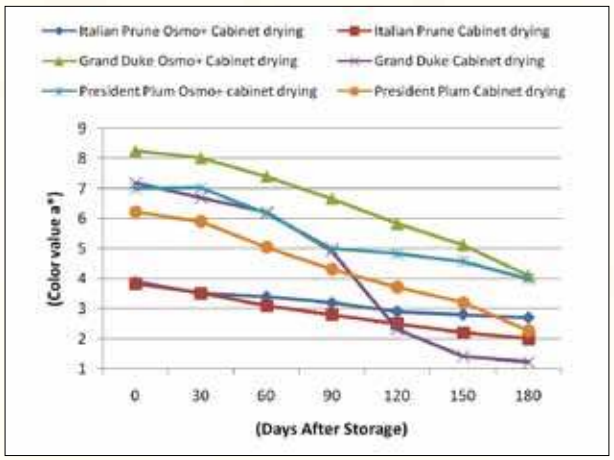


Fig 32: Colour (a*) retention in different cultivars and drying methods during storage period

Standardization of technology for blending of temperate stone fruit juices

Due to rise in consumer awareness and health consciousness, blended fruit juices of different fruits are becoming popular and getting market boost. Stone fruits are rich in anti oxidants,vitamin A, C and various essential minerals. Besides having many dietary and medicinal properties juices of these fruits are having high blending combination producing excellent taste, aroma and flavor. However, it is very much important to standardize the blending ratio of these fruit juices with due importance for taste, quality composition and acceptance.

Standardization of blending of Sweet cherry and Sour cherry juices

Three blending ratio *i.e.*, 25% sweet cherry+ 75 % sour cherry, 50% sweet cherry + 50 % sour cherry, 75 % sweet cherry + 25 % sour cherry with 100% each of sweet and sour cherry with and without treatment of 0.1% Sodium Benzoate and stored at 4±2° C were taken for investigation. After six months of storage study it was found that blend of 50% sweet cherry + 50 % sour cherry treated with sodium benzoate retained maximum desirable colour *i.e.* brightness, redness and freshness when compared with other blending combinations. This blend was also found superior in retaining vitamin C, desirable blend of acidity and TSS. Organoleptic evaluation also confirmed the results.

Standardization of blending of apricot and plum

For experimentation fruits of apricot cv. CITH Apricot-1 and plum cv. President Plum were harvested at right maturity stage. Three blending ratio *i.e.*, 25% apricot + 75 % plum, 50% apricot + 50 % plum, 75 % apricot + 25 % plum with 100% each of apricot and plum juice with and without treatment of 0.1% sodium benzoate stored at 4±2° C were taken for investigation. After six months of storage study it was found that blend of 25% apricot + 75 % plum treated with sodium

Fresh fruits of sweet and sour cherry and their blended juice product

Fresh fruits of plum, apricot and their blended juice product

benzoate retained maximum desirable colour *i.e* brightness, redness and freshness when compared with other blending combinations. This blend was also found superior in retaining vitamin C, desirable blend of acidity and TSS. Organoleptic evaluation also confirms the results.

Assessment of Kashmiri chilli for commercial chemical traits

Biochemical evaluation of chilli germplasm through HPLC analysis and biological assays

A total 22 chilli accessions were evaluated for capsaicin and dihydrocapsaicin through HPLC analysis. Both capsaicin and dihydrocapsaicin was detected at 210 nm, whereas the internal standards for respective capsaicin and dihydrocapsaicin as positive controls and quantitative estimation were detected at the above-mentioned wavelengths. The mobile phase was filtered through a 0.45 µm membrane filter. Quantitative determinations were made by taking into account of respective peak areas of standards at particular retention time versus concentration and expressed in µg/g of dry chilli . Under the optimal isocratic conditions, both capsaicin and dihydrocapsaicin were separated within 1.74 min and 2.3 min respectively. Among 22 chilli accessions (Table 29). CITH-HP-92-13 was found to have highest capsaicin (4010 µg/g), dihydrocapsaicin (1863 µg/g) and pungency (64160 SHU) followed by CITH-91-13 with second highest capsaicin (3573 µg/g), dihydrocapsaicin (1522 µg/g) and pungency (57168 SHU) values.

Chilli sample drying at room temperature for biochemical evaluation

Table 29. Variation in capsaicin, dihydrocapsiacin and pungency traits among 22 chilli genotypes evaluated at ICAR-CITH, Srinagar

S. No.	Genotypes	Capsaicin (µg/g)	Dihydrocapsiacin (µg/g)	Pungency SHU
1	AL-4	1203	623	19248
2	CITH-HP-92-13	4010	1863	64160
3	CITH-91-13	3573	1522	57168
4	SEL-1065-E	3300	1450	52800
5	CITH-HP-42-13	1250	640	20000
6	CITH-HP-85-13	2700	1311	43200
7	KA-2	1500	723	24000
8	SEL-89	1800	847	28800
9	SEL-836-2-1	2937	1311	46992
10	SEL-1011-CE-2(1)	2423	1123	38768
11	SEL-1050	2601	1290	41616
12	SEL-1052-11	1000	489	16000
13	SH-HP-1154-3-1	2570	1243	41120
14	SE-1055-11	2390	1150	38240
15	SH-HP-56-13	2493	1190	39888
16	SHHP-111-1	2673	1298	42768
17	SHHP-1154-2-1	2623	1260	41968
18	CITH-HP-114-13	2200	1023	35200
19	CITH-HP-1154-1	2323	1101	37168
20	SEL-136-1-2	2501	1200	40016
21	SHHP-1154-TT	3000	1322	48000
22	SHHP-111-TT	2483	1185	39728
CD at 5%		*23.147*	*44.17*	-

5. Externally funded/Consortia research platforms/Network projects

Consortium research platform on fungal foliar diseases of apple

Sporulation studies in *Venturia inaequalis*

Experiment on production and sporulation of primary inoculums (Ascospores) of *Venturia inaequalis* on intact apple leaves was conducted during 2016 (Table 30). No ascospore production was observed on current season apple leaves upto 17th April. Initial production of $3.22x10^4$ ascospores with viability of 13.54 per cent was recorded during 18th to 24th April. As soon as the temperature increases production as well as viability of ascospores increases and reaches to a peak production of $9.15 x10^4$ with viability of 96.25 per cent during 23rd to 29th May. Peak viability of ascospores was observed from 23rd to 5th June.

Morpho-Pathogenic variability of *Venturia inaequalis*

Twenty three isolates of *Venturia inaequalis* collected from different locations and bearing different GPS readings were studied after 30 days of inoculation on potato dextrose agar (PDA) media with respect to morphological variation in mycelium, conidiophores, conidia and colony characters. The fungus is slow growing and pin-head growth appears 15 days of inoculation on PDA media. The variation in morphology of different thallus parts is presented in Table 31. Majority of the isolates showed little morphological variations among one another. However, isolates VI-AP Kakapora Pulwama, VI- Del Banigund Pulwama, VI- Del Dangerpora Kulgam, VI- Del Aripalan Pulwama, VI- Del Charari sharif Budgam, VI- Gd Bandipora and VI-AP Kakapora Pulwama were showing much variation from rest of the isolates on the bases of morphological characteristics. Pathogenicity test of 20 different isolates of apple scab collected from various locations in Kashmir valley by adopting detached leaf technique on highly susceptible cultivar "Vista Bella" was conducted under lab. conditions during 2016. The young, succulent leaves were inoculated with 30 days old scab inoculum on four equidistant places. The initiation of disease symptoms first starts to appear 15 days after inoculation in (Del-Aripalan Pulwama) isolate, which also showed highest radial extension of 15.4 mm. Least extension of necrotic area (4.5 mm) was recorded in Del-Kanan Budgam isolate. In rest of isolates radial extension of necrotic area ranges from 5.4 mm to 8.8 mm.

Table 30: Production and sporulation of primary inoculum (Ascospores) of *Venturia inaequalis* on intact apple leaves during 2016

Observation time	Ascospore production (No. X $10^4 cm^{-2}$)	Ascospore viability (%)
11th to 17th April	0.00	0.00
18th to 24th April	3.22	13.54
25th April to 1st May	4.05	44.31
2nd to 8th May	5.14	52.58
9th to 15th May	6.48	74.20
16th to 22nd May	7.85	88.42
23rd to 29th May	9.15	96.25
30th May to 5th June	9.07	92.14
6th to 12th June	6.74	70.84
13th to 19th June	3.27	40.39
20th to 26th June	1.00	15.20
27th June to 3rd July	0.0	0.0

Table 31: Morphological variability of *Venturia inaequalis* on potato dextrose agar after 30 days of inoculation

Isolate	Hyphal width(µm)	Inter septal distance(µm)	Conidial length(µm)	Conidial width (µm)	Conidiophore (µm)
VI-AP Kakapora Pulwama	3.9-4.6	35.7-52.6	21.4-27.0	9.1-11.2	39.4-54.6
VI-AP Salar Anantnag	3.2-4.0	29.3-37.3	17.5-23.5	7.3.0-8.7	36.3-46.9
VI-AP Shumnag Kupwara	3.0-3.9	21.4-30.7	13.6-18.4	6.2-7.2	29.7-40.8
VI- Del Banigund Pulwama	4.2-4.9	38.6-42.8	23.3-29.7	10.4-12.7	41.8-55.1
VI- Del Aripalan Pulwama	2.8-3.5	19.2-27.9	12.9-17.0	5.6-6.5	27.4-38.5
VI- Del Beerwa Budgam	3.3-3.9	25.8-35.1	17.1-22.3	7.2-8.5	35.7-46.1
VI- Del Dangerpora Kulgam	3.7-4.1	33.9-50.0	20.1-25.7	8.2-10.8	37.4-51.8
VI- Del Gantimula Baramula	3.5-4.4	24.9-34.5	16.0-20.0	7.1-7.9	32.6-44.2
VI- Del Hurpora Shopian	3.1-3.6	24.4-34.4	16.5-21.0	6.8-8.1	34.2-44.4
VI- Del Kachen Pulwama	3.1-4.0	21.5-33.3	15.7-20.0	7.8-9.8	34.0-42.1
VI- Del Trehgam Kupwara	3.2-3.4	20.4-30.5	17.0-20.5	7.4-8.5	33.0-45.5
VI- Del Charari Sharif Budgam	2.9-3.8	25.2-35.0	19.2-30.3	6.2-7.0	31.4-37.0
VI- Del Raram Tangmarg	2.9-3.7	22.2-35.0	16.8-21.8	7.5-8.8	36.0-45.5
VI- Gd Bandipora	2.8-3.5	24.7-34.4	18.3-29.5	6.0-6.8	30.7-36.9
VI- Gd Chadoora Budgam	3.4-4.0	23.7-33.8	15.7-19.7	7.0-7.6	31.2-40.2
VI- Del Nehama Kulgam	3.0-3.7	21.0-32.7	15.6-19.4	7.3-8.4	32.9-41.9
VI- Gd Hamray Baramula	3.1-3.9	22.4-35.3	17.0-22.6	7.4-8.8	35.8-45.4
VI- Del Shumnag Kupwara	3.1-3.9	22.9-35.5	16.8-22.0	6.6-7.4	33.9-42.4
VI- Del Srigufwara Anantnag	3.3-4.4	20.4-32.8	15.6-19.6	7.3-8.0	33.6-42.5
VI- Del Tangmarg	3.1-3.9	28.3-37.0	20.1-31.1	6.5-7.4	33.0-39.1
VI- Gd Mattan Anantnag	3.5-4.4	23.0-35.6	17.0-21.9	7.7-8.8	36.6-46.7
VI- Gd Pinjora Shopian	3.2-3.8	21.9-31.8	16.7-21.1	7.2-7.8	34.2-42.4
VI- Gd Kanan Budgam	3.3-4.1	22.7-33.1	16.3-21.4	7.1-7.5	33.9-43.5

In vitro evaluation of different Non systemic fungitoxicants against apple scab

Different non systemic fungitoxicants at 1000, 2000, 3000, 4000 and 5000 ppm concentration in five replications each were evaluated against *Venturia inaequalis* by adopting poison food technique (PFT).The data was recorded 30 days after inoculation, results revealed that highest per cent growth inhibition (86.36%) with mancozeb (4000 & 5000 ppm) and propanib (5000 ppm) with 0.3 cm of radial mycelial growth in both treatments in comparison to 2.2 cm in control. Mancozeb (1000 ppm) proved to be the least effective with 36.36% per cent growth inhibition with 1.4 cm radial mycelial growth over control. The data also revealed that the per cent growth inhibition and radial mycelial growth of other fungitoxicants evaluated varied between the above mentioned values.

Molecular characterization of *Venturia inaequalis* isolates using SSR markers

The genetic characterization of 20 *Venturia* isolates was carried out by analyzing 27 pairs of Simple Sequence Repeat (SSR) markers. A high level of genetic variability was found among the *Venturia* isolates. The polymorphic

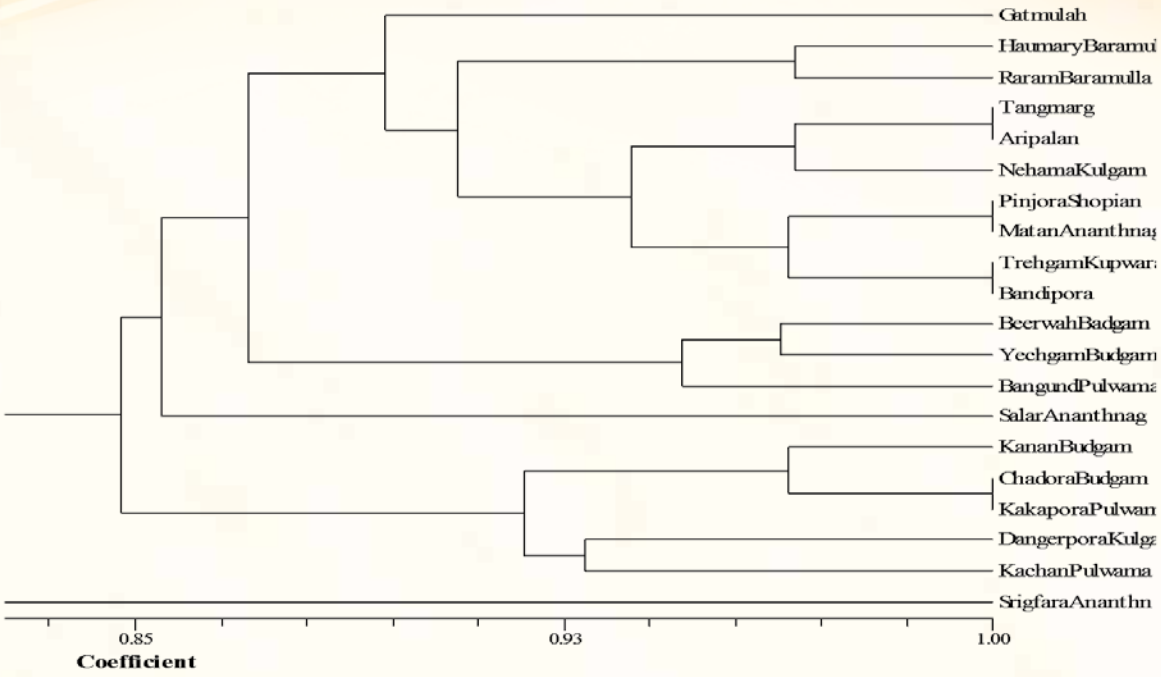


Fig 33: Dendrogram showing grouping of Venturia isolates based on SSR analysis

information content (PIC) ranged from 0.09 to 0.37 and marker index (MI) value ranged from 0.09 to 0.87. Genetic distance analysis divided the *Venturia* isolates into four main clusters with various degree of sub clustering within these four main clusters (Fig 33). The similarity co-efficient ranged between 0.70 to 1 with an average of 0.87. The expected heterozygosity at a given locus ranged from 0.1423 to 0.3846 with an average of 0.0647.Genic variation among the isolates depict that average value of 1.25 for observed number of alleles, 1.08 for effective allele number and 0.10 Shannon's Information Index , thus reveals significant genic variation among the isolates.

Population Structure analysis for estimating genetic divergence and differentiation of *Venturia* isolates

Model-based cluster analysis for 27 pairs of SSR markers grouped 20 isolates into 3 genetically distinct sub-populations with significant level of admixtures {K03, having maximum natural log probability -105.5 (0.0810 mean value of alpha), which is proportional to the posterior probability}. Of the total 20 isolates of venturia, 8 isolates formed one population and 7 isolates form population 2 and 5 isolates formed another genetically distinct population. The overall proportion of membership of sub-populations was 0.351, 0.334 and 0.316

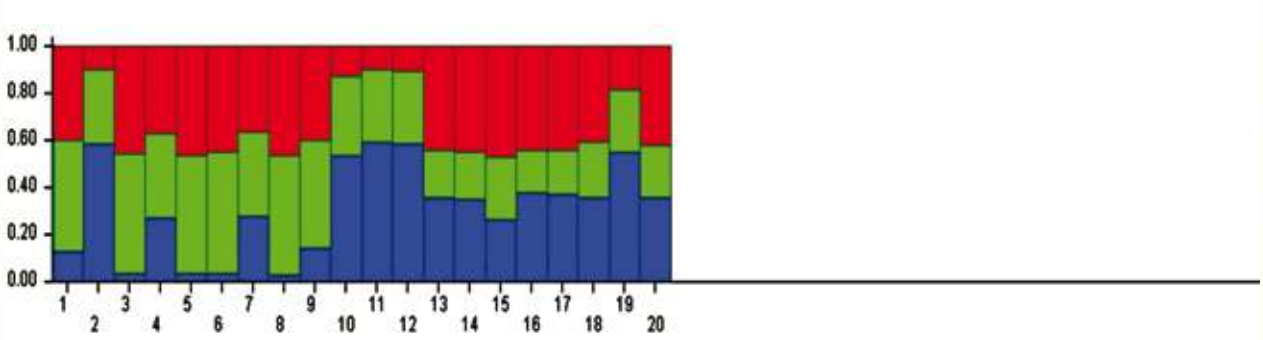


Fig 34: Assignment of Venturia isolates to populations based on STRUCTURE analysis

for sub-population-1, sub-population-2 and sub population-3 respectively. Allele frequency divergence among populations computed using point estimates of P was 0.0032 between sub-population 1 & 2, 0.0083 between sub population 1&3 and 0.0060 between sub population 2 &3. The expected heterozygosity, which measures the probability that two randomly chosen individual will be different (heterozygous) at a given locus were 0.0795 for first sub-population 1, 0.0793 for sub population 2 and 0.0660 for sub-population 3. The Structure analysis during the present study showed genetic divergence/differentiation in the different *Venturia* isolates (Fig. 34).

Molecular characterization of *Alternaria* isolates through SSR markers

The molecular characterization of 47 *Alternaria* isolates was carried out by analyzing 13 pairs of Simple Sequence Repeat (SSR) markers. A high level of genetic variability was found for these two molecular markers among the *Alternaria* isolates AEM13 (0.9842) and AEM5 (0.6747). The PIC values ranged from 0.08 to 0.48 and MI ranged from 0.016 to 0.96. Genetic distance analysis divided the *Alternaria* isolates into eight main clusters (Fig 35). The similarity co-efficient ranged between 0 to 1 with an average of 0.55. The expected heterozygosity at a given locus

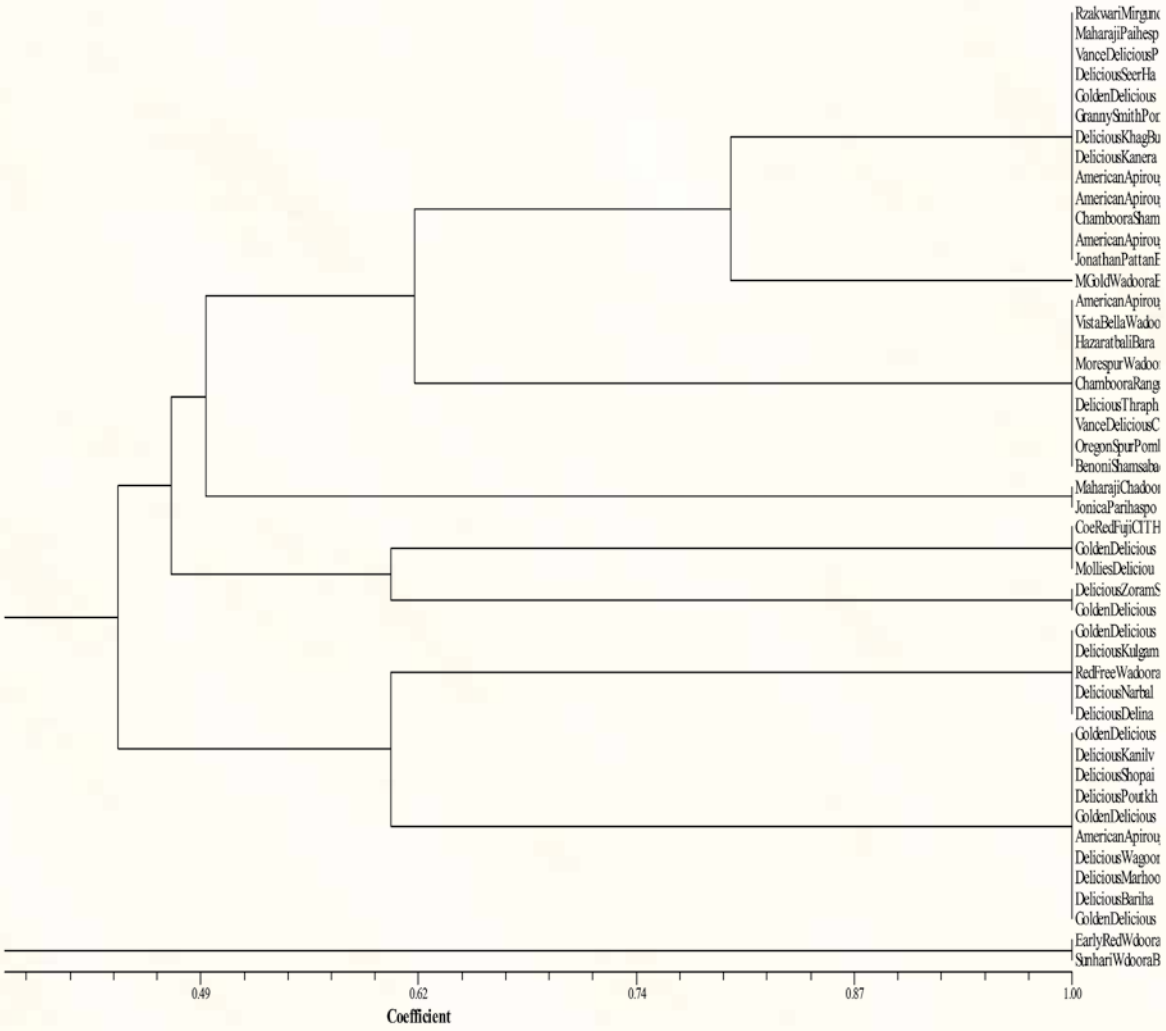


Fig 35: Dendrogram showing grouping of Alternaria isolates based on SSR analysis

ranged from 0.0421 to 0.6076 with an average of 0.3015. Genic variation among the isolates depict that average value of 2.25 for observed number of alleles, 1.64 for effective allele number and 0.48 Shannon's Information Index , thus reveals significant genic variation among the isolates.

Population Structure analysis for estimating genetic divergence and differentiation of *Alternaria* isolates

Model-based cluster analysis for 13 pairs of SSR markers grouped 47 *Alternaria* isolates into 2 genetically distinct sub-populations {K02, having maximum natural log probability -137.0 (0.0758 mean value of alpha), which is proportional to the posterior probability}. Of the total 47 isolates of *Alternaria*, 21 isolates form one population and 26 isolates form another genetically distinct population. The overall proportion of membership of sub-populations was 0.525 and 0.464 for sub-population-1 and sub-population-2 respectively. Allele frequency divergence among populations computed using point estimates of P was 0.211 between sub-population 1 & 2. Similarly, population differentiation measurements (Fst) ranged from 0.275 (in first sub-population) to 0.5226 (in 2nd subpopulation). The Structure analysis during the present study showed genetic divergence/differentiation in the different *Alternaria* isolates (Fig. 36).This spatial divergence may be due to the selection pressure exercised during the selection process.

Consortium platform on borers

For continuous monitoring of different types of borer infestation and their symptoms, surveys were carried out in different orchard blocks located at ICAR-CITH during the year 2016. In addition to hand picking and visual observation, portable light traps and chemical traps have also been installed in different orchard block for monitoring of pest activities. A total of 183 insect pest specimens along with some natural enemies were collected. The plantation surveyed mainly comprised of apple, almond, cherry, plum, peach, and walnut. In addition to that willow, Ulmus and poplar trees were also monitored for their pest complex and possible shift of these towards major horticulture crops. Collected specimens have been preserved and seasonality data maintained for

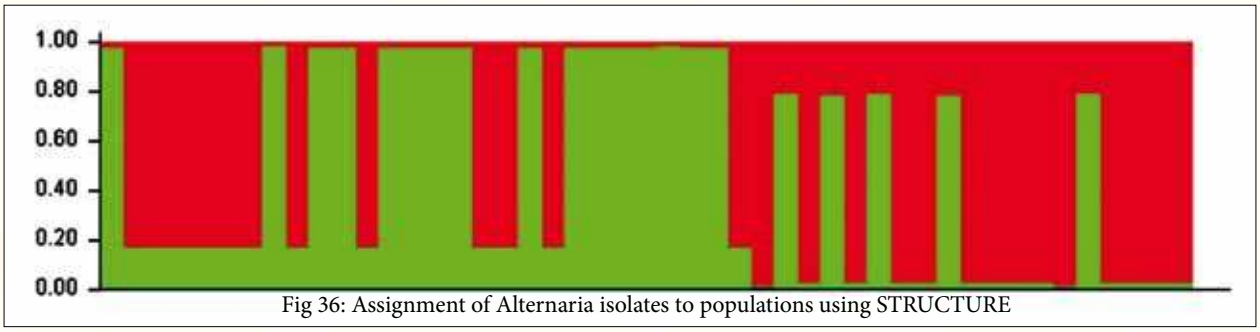
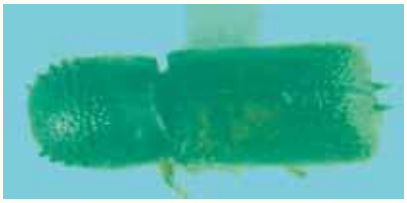


Fig 36: Assignment of Alternaria isolates to populations using STRUCTURE


Scolytus nitidus


Scolytus kashmirensis


Pityogenes scitis


Chlorophorus Quatuor decimmaculatus


Sphenoptera sp


Aeolesthis sarta

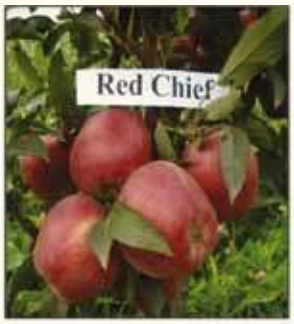
Photographs of some pest species

rationalization of their control measures. Among the collected Scolytine species so far; *Scolytus kashmirensis* Schedl, *Scolytus nitidus* Schedl and *Scolytus rugulosus* Schedl are found to exert maximum damage to the regional horticulture crops. The most severely affected crops by these pests are apple, almond, plum followed by others. The *Sphenoptera* sp are found to exert maximum damage to cherry and almond. While severe infestation of *Aeolesthis holosericea* and *A. sarta* on apple is prevalent in the orchard.

Network project on outreach of technologies for temperate fruit crops

The AINP on OTTFC was initiated in 2009-10. For proper testing and dissemination of new varieties and technologies, 11 different sub projects were formulated and initiated up during 11th plan under different agro-climatic conditions of North Western Himalayas, Arunachal Pradesh and Ooty-Kodai Kanal of Tamil Nadu, with 8 centres i.e., Srinagar, Mukteshwar, Bhaderwah, Solan, Bajaura, Ranichauri, Kodai Kanal and Pasighat. Under high density plantation, a total of five varieties along with two local checks of apple were evaluated for various horticultural traits. Plant growth characteristics at all the assigned centres were normal. Highest yield was obtained in Oregon Spur at Srinagar and Mukteshwar while at Kodaikanal, growth parameters were found to be good in Mayan. Likewise Mollies Delicious recorded highest yield at Kodai Kanal and Solan. At Pasighat center the performance of plant growth characteristics like plant height, girth and canopy spread of low to mid chill cultivers were appreciable. In medium density orcharding of almonds, optimum plant growth was observed in all the cultivars at different location in J&K. Maximum plant height and girth was recorded in almond cv. California Paper Shell however maximum spread was found in cv. Pranyaj. At Kodia Kanal, the cv IXL produced more number of fruits. Best performance was recorded by cultivar Merced at Mukteshwar. Ten genotypes (CITH-W-01, 02, 03,04,05,06,07,08,09 and 10) along with Hamdan, Suleiman and Opex Cultery as local check of walnut were evaluated under medium density planting system. Maximum plant height was recorded by CITH-W-1 at Srinagar and Kodai Kanal. At Mukteshwar growth performance of CITH-W-1, 2, 3&5 was appreciable. In Solan maximum nut weight was recorded in CITH-W-2 which was significantly superior to all other genotypes. Evaluation of apricot cultivars under medium density planting system was normal and satisfactory. CITH-AP-1 recorded highest plant height at Kodai Kanal. Highest fruit weight, length, diameter, TSS and yield was noticed in CITH-AP-1 at Srinagar. At Mukteshwar, and Pasighat CITH-AP-1, CITH-AP-2, and CITH-AP-3 preformed better over commercial check *i.e.* New Castle**.** Highest fruit yield was observed in CITH-AP-2 in Solan. Under Plant Architectural sub project, impact of training systems and rootstocks on growth and development of spur in apple were studied. A significant difference for plant height was observed at Kodai Kanal. At Srinagar, Oregon Spur/ M-7 combination trained on Tatura Trellis recorded highest yield (4.21kg/ plant.) and lowest in Spartan on M-7 trained on Vertical Axis. In testing of identified varieties of temperate fruit crops sub-project, maximum plant height was recorded in cherry cultivar CITH-C-2. The maximum plant spread East -West and North -South spread was recorded in CITH-C-1 and CITH-C-2 respectively at Mukteshwar. Under water harvesting and moisture conservation techniques in apple under rainfed area sub project, highest plant height recorded in full moon + plastic mulch at Solan, however maximum soil moisture content was observed in full moon + plastic mulch. Under survey and mapping of major pest and disease of temperate fruits, maximum severity of powdery mildew was recorded in month of July at Mukteshwar and in May at Pasighat. *Alternaria* Leaf Spot showed first appearance in April & first week of September and severity in May & Sept. /Oct. in Pasighat and Mukteshwar, respectively.

Oregon spur at Kullu



Red Chief at Kullu

Oregon spur at Srinagar

Silver spur at Srinagar

Vista Bella at Solan

Mayan at Solan

CITH-AP-2 at Srinagar

CITH-AP-1 at Kullu

CITH-AP-2 at Kullu

CITH-AP-1 at Srinagar

Full moon + Organic mulch

Full moon + plastic mulch

Short term training programme in Pasighat centre on Human Resource Development

Challenge Programme on Canopy management and plant architectural engineering on temperate fruits

Canopy management and plant architectural engineering in temperate fruit crops was started during 2015-16 to develop efficient plant architectural systems using different rootstocks and scion cultivars; to harvest solar energy through increased light interception and improve sink source relationship; to utilize maximum vertical space & energy and to maximize production and improve color and quality of produce. Project was implemented in 8 centres with different temperate fruit crops of their regional importance viz Srinagar (apple & pear), Mukteshwar (apple & peach), Dirang (apple), Solan (Peach), Kullu (apple & plum), Ludhiana (pear & plum), Kodai Kanal (pear & plum) and Meghalaya (kiwifruit & peach).

At Srinagar centre, apple and pear were selected for experimentation. In apple highest fruit weight was recorded in the fruits harvested from Oregon Spur on MM-111 trained on spindle bush. Fruit length and diameter was found highest in Oregon Spur on seedling trained on vertical axis. Colour parameters viz. L*, "a*, b* and tint was found highest in Oregon Spur on MM-106 trained on modified central leader system however, firmness in terms of Relative Index (RI) was observed highest in Red Delicious on M-9 trained on modified central leader system. Highest light interception was recorded in Red Delicious-seedling combination on spindle bush training system. In pear architectural engineering block was established in year 2015. Overall growth performance was found excellent however, Kashmiri Nakh on both BA-29-C and Quince-C showed more plant height, girth and spread. Highest fruit weight was noticed in William Bartlett on Quince-C trained on modified central leader system whereas TSS was highest in vertical axis training system in Kashmiri Nakh on Quince-C. Performance of nectarine and peach in different planting systems at Solan reveals that highest plant height and annual extension growth was recorded in Snow Queen on tatura trellis training system, however, highest tree spread was observed in Red Haven. At Ludhiana plant height was higher when pear plants were grafted on Kainth rootstock and dwarfing effect of Quince C rootstock is apparent. However, the maximum plant height was recorded in Punjab Beauty/ Kainth combination. Highest plant height was recorded in Partap on central leader both at Basar, Arunachal Pradesh and Umiam Meghalaya.

Starkrimson on BA-29C at Srinagar

William Bartlett on Quince-C at Srinagar

Oregon Spur on M-9 on Vertical Axis system at Srinagar

Oregon Spur on MM-106 on Cordon system at srinagar

Oregon Spur on MM-106 on Espalier system at Srinagar

Oregon Spur on MM-106 - on MCLS at Srinagar

National Mission for Sustaining Himalayan Eco System (NMSHE-TF-6)

District wise metrological data was compiled for four years (2006-2010). Data acquired from secondary sources regarding area and production of different horticultural crops, ground water draft and ground water availability, net sown area, irrigated area, wasteland area and forest cover etc., of various districts in J&K was compiled. Keeping in view the bunch bearing trait of walnut, survey of 4 villages of block Chadoora of the district Budgam was conducted. During the survey about 350 walnut trees were observed and five genotypes with bunch bearing having maximum of 9 nuts per bunch were found. In pilot studies, three demonstrations were laid out for technology revalidation on farmer field under NMSHE-TF-6. One demonstration was laid at village Chattargam of district Budgam (J & K) and two demonstrations were laid at village Ranbirpur Thiksey and Nimmu of District Leh (J &K) including four crops apple, apricot, almond and walnut. Three days farmers' training was organized in Leh under NMSHE-TF-6. One bunch bearing walnut genotype was identified from Budgam district of Kashmir valley having maximum terminals with bearing fruits in bunches ranging 2-10 fruits per bunch. In this genotype, mean nut weight, kernel weight and kernel recovery was recorded 13.11g, 6.16g and 46.24% respectively. A three days training on "Basics of Orchard Establishment and Management in Cold Arid Region" was organised in Leh-Ladakh (23-26th Dec., 2016). Vegetable seed kits were also provided for the farmers for demonstration.

A bunch bearing walnut genotype identified from Kashmir

Demonstration laid at Chattergam (Budgam), RanbirpurThiksey and Nimmo (Leh)

Farmers Training in Chuchot, Ranbirpur-Thiksay and Nimmo village of Leh

National Mission for Sustaining Himalayan Eco System (NMSHE-TF-6) Mukteshwar

In this project three villages viz., Sunkiya (Nainital, UK) as hot spot village, Jur Kafun (Almora, UK) as pilot site 1 and Kumbhali (Shimla, HP) as pilot site 2 were selected for implementing the project work and activities and the base line data was collected. A total of 22 different extension programmes viz., awareness (FAP), training, demonstrations and diagnosis, visits were organized in selected villages namely Sunkiya, (Nainital, UK), JurKafun (Almora UK), Hartola (Nainital, UK) and Kumbhali (Shimla HP). Besides, this one project review meeting with nodal officer of the project was also organized at CITH RS Mukteshwar. Different demonstrations were laid out on apple cvs. Golden Delicious, Chaubattia Princess, Oregon Spur, Skyline Supreme, CITH Lodh Apple-1, peach cvs. Red June and Paradelux, plum cv. Santa Rosa, apricot cvs. CITH- A-1 and CITH-A-3, kiwifruit cvs. Allison, Haward, Tomuri, Abbot, Monty and Bruno. Besides tomato cvs. VL-4 and Pusa Divya, pea cvs. VL-7 and VL-10, Broccoli cvs. KTS-1, Lettuce cv. Solan Kirti, Chinese Cabbage cv. Solan Band Sarson in selected village were also included in demonstrations.

National saffron Mission for economic revival of J & K saffron sector

Apocarotenoid Biosynthesis in saffron – Study during flower development stage, storage conditions and under in-vitro conditions

Apocarotenoid biosynthetic potential of *in-vitro* developed stigmas was as high as natural stigma. Crocin content of *in-vitro* developed stigma and natural stigma was 20mg/g and 35mg/g and 0.12 and 0.22 mg/g safranal content of dried stigma respectively. This clearly shows that *in-vitro* developed stigmas (Fig 37) have very high potential for apocarotenoid biosynthesis. These structures are developed from callus as an intermediate which does not show any signs of apocarotenoid biosynthesis. Our results showed that once stigma development starts under *in-vitro* conditions from callus apocarotenoid biosynthesis pathways also get activated simultaneously. Gene expression of key apocarotenoid biosynthetic genes viz *CsZCD,* and *CsLYC* in *in-vitro* developed stigma, callus and natural stigma was investigated. Expression of their transcripts both through semi-quantitative (Reverse Transcription PCR) and quantitative (Real Time PCR) analysis was compared. Relative semi-quantitative expression of *CsZCD* and *CsLYC* genes was done between *in-vitro* developed stigma, stigma and callus. Relative apocarotenoid gene expression between natural and *in-vitro* developed stigmas was done through quantitative real time PCR analysis. Significant variation in apocarotenoid gene expression was observed between two types of developmentally diverse tissues. *In-vitro* developed stigma showed only 75 % and 63% expression of *CsZCD* and *CsLYC* to that of natural stigma No gene expression was observed in callus tissue suggesting that during the development of *in-vitro* stigma concomitant changes in expression of apocarotenoid biosynthesis genes and the biosynthesis of apocarotenoids occur. This is the first report of quantitative analysis of *CsLYC* and *CsZCD* gene expression in *in-vitro* developed stigmas. The prelude to this would be to validate a set of apocarotenoid biosynthesis genes during

Glimpses of Activities conducted under NMSHE project in selected villages by RS Mukteshwar

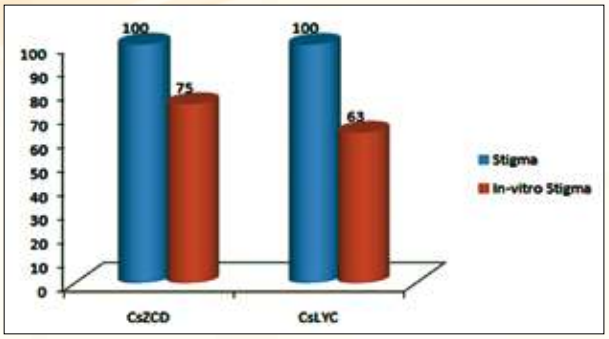


Fig 37: Relative gene expression studies of apocarotenoid biosynthetic genes in in-vitro developed stigma with reference to natural stigma

the development and maturation of *in-vitro* developed stigmas to ascertain their potential for apocarotenoid biosynthesis and accumulation.

Standardization of harvesting time in saffron – Apocarotenoid value indexing:

Saffron stigma harvesting is usually done after flower opening or few days after flowering but the quality of stigma which is determined by its color and aroma contributed through crocin and safranal content is decreased after flower opening. In present study three stages of flower opening were selected viz balloon stage when tepals were not opened, second stage was taken when tepals initiated opening and stigma was taken on the same day of flowering and third stage was taken when tepals were completely opened i.e. after two days of flowering. HPLC quantification of crocin and safranal was done and it was found that maximum crocin (4.7 %) and safranal (0.05%) equivalent to 47mg/g and 0.5mg/g of stigma was found in balloon stage (Table 32) which was decreased in second stage and further decreased to 3.2% and 0.018% respectively in third stage. Thus in order to harvest the quality stigma of saffron harvesting should be done at balloon stage of stigma development.

Table 32: Apocarotenoid quantification during pre- and post flowering stages

Stage of flower opening/ harvesting	Crocin (%age)	Safranal (%)
First (Balloon stage- unopened flower)	4.7	0.05
Second (Just opening flower – same day of flower opening)	3.8	0.02
Third (fully opened flower – two days after flower opening)	3.2	0.018

Retention studies for apocarotenoid content of saffron during different drying methods

Different drying methods were tried to standardize the drying technology for retaining maximum apocarotenoid content and thus quality of the stigma. Cabinet drying at 80°C was found to retain maximum quality of stigma. Crocin content of saffron when dried under cabinet dryer was higher (3.4%) followed by the stigma dried under tunnel dryer with black polythene (3.0%) and minimum crocin content (2.6%) was found in stigma dried under tunnel dryer with white polythene (Table 33). Similarly safranal content of 0.032%, 0.023% and 0.022% was found in cabinet dryer, tunnel dryer with black polythene and tunnel dryer with white polythene. The reason for maximum retention under cabinet dryer is high temperature which may prevent their further conversion and also prevent their degradation. Black polythene harvesting higher energy/ heat and thus maintains higher temperature in the tunnel which was observed by keeping thermometer and it was found to have approx 6°C higher temperature when natural temperature was about 30°C. Cabinet drying also saves time and maintains integrity of trifid stigma.

Baloon stage-I (unopened flower) Start of flower - II opening Completely opened flower - III

Three flowering stages used for apocarotenoid quantification

Table 33: Different drying systems used for drying of saffron stigma

Drying method	Crocin (%age)	Safranal (%)	Picture/Image of the system
Cabinet dryer (at 80°C for	3.4	0.032	
Tunnel (white-transparent polythene)	2.6	0.021	
Tunnel (black-opaque polythene)	3.0	0.023	

All India Co-ordinated Research Project (AICRP) on Vegetable Crops

ICAR- CITH, Srinagar:

In AICRP on vegetable crops at Srinagar, evaluation was carried out in chilli, tomato and sweet pepper. The observations and results of varietal trials conducted in chilli, tomato and sweet pepper are shown in Table 34. In addition to conducting trials, one chilli entry CITH-HP-1154-3-1 and two sweet pepper entries CITH-SP-603 and CITH-SP-3-1 from our centre have reached advanced varietal trials under AICRP.

Table 34: The best performing varieties of different crops over check

Trial	No. of entries	Entry better than check for fruit yield (q/ha)
IET Chilli hybrids	6+1 C	2015/CHIHYB-4 (432.64) 2015/CHIHYB-5 (397.81)
AVT-I Chilli hybrids	7+2C	2014/CHIHYB-1 (442.32) 2014/CHIHYB-6 (338.07)
AVT-II Chilli hybrids	7+1C	2013/CHIHYB-1 (516.96) 2013/CHIHYB-8 (264.63) 2013/CHIHYB-7 (257.35)
AVT-I Chilli varieties	10+2C	2014/CHIVAR-9 (478.02) 2014/CHIVAR-7 (445.62)
AVT-II Chilli varieties	4+2C	None
IET Tomato hybrid (determinate)	4+2C	None
AVT-I Tomato hybrid (determinate)	8+2C	None
AVT-II Tomato hybrid (determinate)	5+5C	None
IET Sweet pepper varieties	4+2C	None

Mukteshwar Centre

Protected cultivation in cucumber

Among the genotypes tested, the Multistal recorded highest values for vine length (4.00 m), number of fruits/plant (14.33), fruit yield/plant (2.89 kg), whereas average fruit weight was recorded maximum in Pant C-2. The var. Pant C-3 exhibited highest values for number of branches/plant (4.00) and fruit length (22.06 cm) in mid hill under polyhouse.

Production of cherry tomato under controlled environment

Eight genotypes/lines of cherry tomato were evaluated during 2016 at ICAR-CITH, RS, Mukteshwar, Nainital (Uttarakhand) for their growth and yield parameters. Most of lines exhibited significant differences for growth and yield parameters. Among the genotypes number of fruits/plant (379.66) recorded maximum in CITH-CT-4 and minimum (52.66) in CITH-CT-06. However, highest fruit weight (29.19 g) was recorded in CITH-CT-6 and minimum 98.43 g in CITH-CT-4. Maximum average fruit yield/plant (3200.53 g) was recorded in CITH-CT-4 and lowest (920.00 g) in CITH-CT-5.

All India Network Research Project on Onion & Garlic

This project was implemented at ICAR-CITH, Srinagar and ICAR-CITH, RS, Mukeshwar. The brief achievements in this project are summarized under different heads below:

Srinagar Centre

Collection, evaluation and conservation of germplasm

Surveyed and collected two new entries in onion and 4 in garlic on the basis of morphological variability from different parts of Kashmir. Evaluated 69 existing collection of onion and 68 of garlic. CITH-O-40 (212.44 t/ha) and CITH-G-20 (44.15 t/ha) of onion and garlic, respectively, were found to be the best yielders. Seven EC collections of onion, 50 long day garlic entries of garlic and varietal trials of onion and garlic supplied by ICAR-DOGR, Pune were also evaluated.

Effect of micronutrient application on yield and storage quality of onion

Among six treatments including control (RDF), T4 (foliar application of 0.25% borax at 30 and 45 DAT) gave the highest yield (51.54 t/ha) and statistically superior than the check (28.48 t/ha).

Bearing and fruits of different cherry tomato at Mukteshwar

Effect of zinc and boron application on yield and storage quality of garlic

Foliar application of 0.25% boron at 30 and 45 DAT resulted in highest marketable yield while all treatments were at par for dry matter content of the bulbs. Nitrogen, Phosphorus and Zinc content of bulbs were highest by spray of micronutrient mixture at 30 and 45 DAT. Sulfur and Iron were reported to be highest in case of basal doze of borax @ 10kg/ha.

Effect of drip and surface irrigation on yield and yield parameters of onion

Drip irrigation with chemical nutrition was at par with control i.e. flood irrigation, with chemical fertilizers and was better than drip irrigation with organic nutrition and flood irrigation with organic nutrition.

Effect of Sulfur on yield and quality of garlic

The treatments T2 (15 kg/ha S), T3 (30 kg/ha S), T5 (60 kg/ha S) and T6 (75 kg/ha S) were at par for marketable yield and T1 (No S), T4 (45 kg/ha S), T5 and T6 were better for TSS.

Seasonal incidence of onion thrips in Kashmir valley

Among 9 standard weeks, 25th standard week i.e. last week of June recorded the highest thrips population i.e. 35.5 thrips/plant.

Seasonal incidence of garlic thrips in Kashmir valley

Among 9 standard weeks, 25th standard week i.e. last week of June recorded the highest thrips population i.e. 28.16 thrips/plant.

Effect of different planting dates on yield loss due to thrips and major foliar diseases of onion

Among 8 transplanting dates, the lowest yield loss due to thrips and foliar diseases was found in transplanting date of 1st December.

Effect of different planting dates on yield loss due to thrips and major foliar diseases of garlic

Among 8 transplanting dates, the lowest yield loss due to thrips and foliar diseases was found in transplanting date of 1st November.

Effect of foliar application of S, B and CaCl2 on storage life of onion bulbs

All the treatments were better than control and at par with each other for yield. However, T3: 0.5% K2SO4 spray at 45, 60 and 75 DAT resulted in lowest cumulative weight loss during storage.

View of onion and garlic field at ICAR-CITH under various experiments

Mukteshwar centre

AVT-I on long day garlic

Thirteen genotypes of long day garlic were evaluated and among the lines, GN-14-11 recorded maximum bulb yield (2.434 kg/plot and 243.40q/ha.) Three top ranking genotypes for average bulb weight were GN-14-11, GN-14-21 and Local Check with 45.46 g, 39.86 g and 31.40 g, respectively.The genotype GN-14-23 recorded maximum number of cloves per bulb (28.86) followed by GN-14-17 (22.53) and GN-14-13 (21.00). Maximum TSS of 42.13 ^{0}brix was recorded in genotype GN-14-15.

AVT–II on long day garlic

Ten genotypes of AVT-II long day garlic were evaluated and GRL-1330 was found top ranking in term of bulb yield of 1.538 kg/plot and 153.80q/ha followed by GRL-1332 and Local Check which produced 1.178 kg and 1.145 kg bulb yield/plot with 117.8 q/ha and 114.50 q/ha, respectively. The total soluble solid content was found maximum in genotype GRL-1340 (40.53^0 brix)

View of garlic field at ICAR-CITH, Regional Station , Mukteshwar under various experiments

IET on long day Onion

Sixteen genotypes of IET long day Onion were evaluated and highest yield was found in genotype i.e. ON-15-33 (10.613 kg/plot and 1061.30q/ha) which also exhibited higher values for average bulb weight (186.13g), plant height (65.313cm) polar and equatorial diameter of bulb (54.69 and 76.10 mm) leaf length (56.23 cm).

AVT I on long day Onion

Most of genotypes tested under AVT-I exhibited significant differences for various traits under studied. The highest yielder genotype i.e. ON-14-23 (9.117 kg/plot and 911.70 q/ha) also exhibited higher values for plant height at harvesting stage (62.48 cm), average bulb weight (197.46 g), polar and equatorial diameter of bulb (62.42 and 74.82 mm) and leaf length (54.65 cm).

AVT II on long day Onion

Among the 13 genotypes, OLR-1343 exhibited higher values for total bulbs yield per plot (8.891 kg/plot and 889.91q/ha), plant height (64.60 cm) at harvesting stage, maximum polar and equatorial diameter of bulb (64.48 and 76.19 mm), leaf length (56.14 cm), average bulb weight (206.00g). Highest TSS content recorded in genotypes ALRO-1213 (14.60 ^{0}Brix) followed by OLR-1364 (13.00 ^{0}Brix). However, maximum A grade bulbs were recorded in OLR-1343 (53.33%) and minimum in OLR-1352 (15.66%).

AVT-II on Long day Onion Hybrid

Nine genotypes of AVT-II long day Onion hybrid were evaluated and highest yielder genotype i.e. OLR- 1388 (7.994 kg/plot and 799.40 q/ha) also exhibited higher values for plant height at harvest (52.926 cm), average bulb weight (144.93 g), polar and equatorial diameter of bulb (60.286 and 74.433 mm), leaf length (44.96 cm)

View of onion nursery at Mukteshwar

Livelihood and Nutritional Improvement of Tribal Farm Women through Horticulture

In this project base line data of Nithila village was collected. Generally, farmers are growing tomato, cabbage, potato, cucumber, bitter gourd, pea, maize, ginger, beans, garlic, onion, rice, oat and wheat, however very limited number of pear, peach, plum, apricot and walnut plants were also observed. In valley area, farmers have planted mango, litchi, pomegranate, etc also. Some farmers are also rearing animals in limited numbers viz., goat, buffalo, sheep and cows besides poultry.

Programmes/activities conducted

Following programmes / activities were conducted in the village under this project.

Table 35. Activities conducted in the village

Date	Activity
22.10. 2016	Conducted FAP-training programme under the project "Livelihood and Nutritional Security of Tribal Farm Women through Horticulture" at Nithila village.
22 &23 Jan. 2017	Conducted FAP-training programme in Mathew and Nithila villages Under the project "Livelihood and Nutritional Security of Tribal Farm Women through Horticulture".

Besides, the seeds of tomato cv. VL-4 capsicum cv. California Wonder and broccoli cv. KTS-1, lettuce cv. Ice Berg were provided to the farmers of Nithila and Mathew villages. Likewise apple, peach, plum, apricot and kiwifruit plants were also planted at the farmer's field of Mathew village for upliftment of the livelihood and nutritional security.

FAP in Nithila Village

FAP in Mathew Village

Micronutrient management in horticultural crops

In order to know the micronutrient status of apple growing soils of Kashmir valley, an exhaustive survey was conducted and areas with nutrient deficiencies were identified. Further, to understand the deficiency of these micronutrients leaf analysis was done and leaf micro nutrient concentration was revealed (Fig.38). In order to identify the nutrient deficiency a mobile application Nutrient Deficiency Diagnoser and Manager for Apple was developed. The app was developed in three languages covering the common languages of the farmers of the apple growing areas of India. Besides diagnosing the deficiency, the app suggests management too.

Mobile application developed to diagnose and manage nutrient deficiency in apple

National innovations on climate resilient agriculture

Climate change impact on phenological stages of different varieties of apple revealed a significant impact of temperature variation on timing of attaining various phenological stages (Fig. 39). The impact was more pronounced on the initial or early stages. This change in arrival of various phenological stages may have significant effect on apple yield.

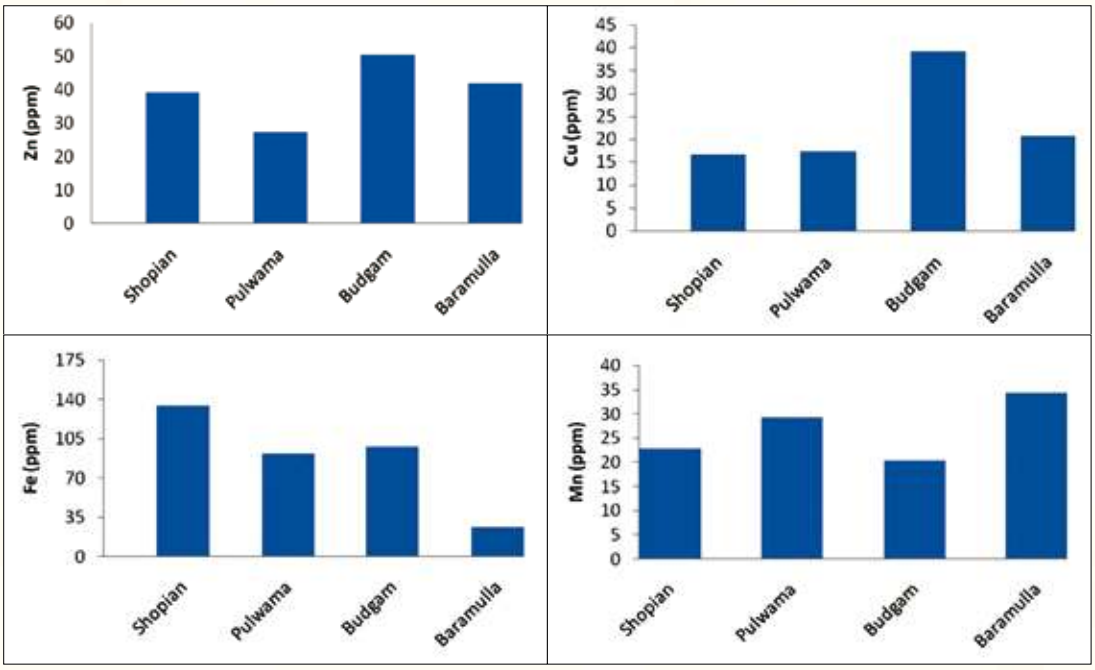


Fig 38. Leaf micronutrient concentration of major apple growing areas of Kashmir

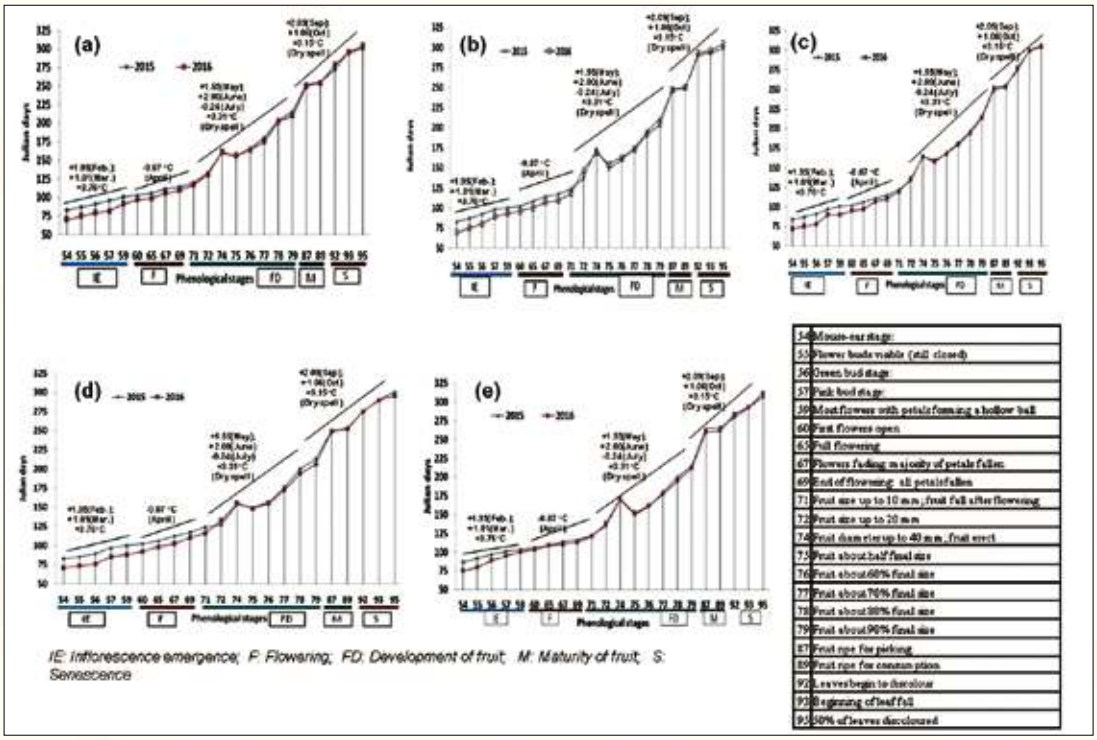


Fig 39. Advancement/delay in phenological stages as influenced by mean temperature in (a) Red Delicious, (b) Golden Delicious, (c) Royal Delicious, (d) Oregan Spur and (e) Coe Red Fuji

Meetings and Events

4

Model training course organized

An eight-day Model Training Course on "Post-Harvest Management of Temperate Fruits and their Value Addition" was organized from 18-25th March 2017 at ICAR-Central Institute of Temperate Horticulture, Srinagar (J&K). The training was sponsored by Directorate of Extension, Department of Agriculture cooperation & Farmers welfare, Ministry of Agriculture & Farmers welfare, Government of India. The main objective of the training was to create awareness among the horticulture officers/extension functionaries of different states on recent trends in post-harvest management and value addition technologies for reduction of losses and income generation through entrepreneurship development. Besides field visits, hands on training on post harvest management and preparation of value added products was also imparted. A total of 23 state department officials from Arunachal Pradesh, Himachal Pradesh, Uttarakhand and Jammu and Kashmir participated in the programme.

Welcome to Director, ICAR-CITH and participants during Model Training Course

13th Research Advisory Council Meeting

The 13th meeting of RAC was held on 4 - 5th May 2016 at CITH, Srinagar under the Chairmanship of Padma Shri Dr. K. L. Chadha. The members of RAC who attended the meeting were Dr B Venkateshwarlu, Dr. A. A. Sofi, Dr. V.V. Ramamurthy, Dr. S. K. Tikoo, Dr. J L Karihaloo, Dr. Hina Shafi, Dr. D B Singh and Dr. O C Sharma. The scientists of CITH and NBPGR also attended the meeting.The member and chairman gave critical input on experimentation for obtaining realistic and reproducible results. Discussion was also held on initiation of new proposals. The committee members also visited the experiments in the field.

Director, ICAR-CITH presenting brief achievements during RAC

Workshop and Awareness Programme on Olive celebrated at CITH, Srinagar

One day workshop and awareness programme on olive was celebrated at ICAR-Central Institute

Olive Workshop

of Temperate Horticulture, K.D. farm, Old Air Field, Srinagar on 22nd Oct, 2016. Scientists from SKUAST-K, officials from State Development Department and 150 farmers from different districts of Kashmir participated in this event. All the participants were taken to olive research field where detailed discussion was made on olive varieties grown at CITH, pollination management in olive, use of ITKs and novel technologies for addressing propagation problems in olive, area expansion under olive cultivation, breeding opportunities for varietal development in olive, use of biotechnological interventions for olive crop improvement etc. During the interaction Dr. Desh Beer Singh, Director, CITH and Dr. Shiv Lal, Scientist, CITH provided detailed know how about olive cultivation done under scientific way at ICAR-CITH, Srinagar.

State-wise coordination committee for doubling the farmers' income by 2022

The first meeting of the Co-ordination Committee for Doubling the Farmers' Income in Jammu and Kashmir State by 2022 was held at Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, Jammu on 24th March, 2017 under the Chairmanship of Dr Pradeep K. Sharma, Vice Chancellor, Sher-e-Kashmir University of Agriculture Science and Technology-Jammu. Dr D. B. Singh, Director, ICAR-CITH, Srinagar, convener of the committee made a presentation on the Objectives and Agenda of the meeting. He informed that in the State of J&K, the share of Agriculture and allied sector to GDP is 20.6% and this sector supports the livelihood of about 70% of the population. Dr Pradeep K. Sharma, Vice Chancellor of SKUAST-J observed that three pronged approach was needed to double the income of farmers in a given time-frame viz (a) increasing the productivity, quality production and reducing the cost of production, (b) access to assured market and (c) Policy support. Directors of State Development Departments and other Senior Officials of State Government Departments attended the meeting and provided significant inputs.

Other Events

The ICAR-CITH staff also celebrated other events which were organized time to time in the campus. All the staff participated actively in these events. The list of events is given in next page:

Members of coordination committee discussing on various issues for doubling farmers income by 2022

Table 36. List of the events organized at ICAR-CITH

Events	Date	Organizer
Gandhi Jayanti celebration	2nd October, 2016	Mr Lal Chand
Armed Forces Flag Day	7th December, 2016.	Mr Lal Chand
National Science Day	28th Feb., 2017.	Mr Lal Chand
Swachta Pakhwadas (fortnight)	16th May to 31st May, 2016 & 16th Oct to 31st Oct 2016	Dr K L Kumawat and Mr Lal Chand
Institute Foundation Day	23rd May 2016	Dr D B Singh and Dr J I Mir
Communal Harmony Campaign week and flag day	19 to 25th Nov., 2016	Dr Susheel Raina and Dr Sajad Un Nabi
Agricultural Education Day	3rd Dec., 2016	Dr W H Raja
Hindi Week	14-21.9.2016	Dr O C Sharma and Dr. K L Kumawat
Vigilance Awareness week	31.10.16-5.11.16	Dr O C Sharma
National Productivity week	12.2.17-18.2.17	Dr J I Mir
Yoga Day	21st June, 2016	Dr K L Kumawat

Hindi week

Hindi Week was celebrated by ICAR-Central Institute of Temperate Horticulture, Srinagar and its Regional Station, Mukteshwar from 14 to 21nd Sept., 2016 for compliance of official language policy. Institute organized some competition for students, staff members and their children.

Address by Director and Prize distribution during Hindi Week

Vigilance week

ICAR-Central Institute of Temperate Horticulture, Srinagar and its Regional Station, Mukteshwar observed Vigilance Awareness Week w.e.f 31st Oct to 5th Nov,2016.The theme of the week was " Public Participation in Promoting Integrity and Irradicating Corruption". Director ICAR-CITH emphasizes and objectivity in governance for eradication of corruption from public life.

Staff of ICAR-CITH, Srinagar took pledge on vigilance week

National Productivity Week

ICAR-Central Institute of Temperate Horticulture, Srinagar celebrated National Productivity Week from February, 12-18, 2017 under the theme "From waste to profits through Reduce, Recycle and Reuse". During the inaugural session Dr Javid Iqbal Mir, gave a power point presentation on "Importance of waste reduction, recycling and reutilization for obtaining profit from waste" and he demonstrated the importance of 3R's for enhancing the productivity of the community in general and nation in particular. During the week activities related to 3R's were taken upon and the week ended with the cleanliness drive of the Institute and disposal of waste for recycling

Staff participated during national productivity week

Gandhi Jayanti Celebration on 2nd October, 2016

Swacchta drive organized on 2nd October

CITH staff taking Swacchta Pledge

Armed Forces Flag Day celebration

Communal Harmony Week

Armed Forces Flag Day celebration

Extension and Other Programmes

5

Extension Activities

The temperate fruit industry in India is associated with many production problems and lack of knowledge of latest technologies which leads to low productivity in these crops as compared to other countries. There is a great scope to increase the productivity of quality produce in temperate horticultural crops if farmers/ stake holders are made aware of latest and scientific technologies generated by various institutions. The ICAR- CITH has made continuous efforts through various research programmes to generate farmer friendly technologies, and recognized as nodal working institute on temperate horticultural crops in the country. The number of stakeholders of CITH is continuously increasing throughout the country. The Central Institute of Temperate Horticulture, Srinagar and its Regional stations are putting continuous efforts to make the farmers/ officers of line departments aware of various new technologies generated in temperate horticultural crops for improving productivity and quality.

The Institute has tried to disseminate various technologies by organizing number of programs for human resource development. For the quick adoption of technologies, CITH is continuously organizing vocational trainings, model training courses, crop days, on campus and off campus trainings as well as demonstrations, ghoshtis, farm visits, diagnostic visits, supply of quality planting material, publication in local language, participation in farmer fairs, radio talk, TV shows and display of exhibits on various occasions/ farmers fair etc. The details of various programmes organized at CITH during the year are presented below:

Training programme on Canopy Management and Plant Architecture Engineering

Short term training programme on "Canopy management and plant architectural engineering in temperate fruits crops" was organized by ICAR-CITH, Srinagar during January 16-18, 2017 at ICAR-CITH, Srinagar. Officials from Department of Horticulture, Baramulla, J&K, Department of Horticulture and Food Processing, Uttarakhand and technical staff of ICAR-CITH, Srinagar participated in this programme. During the training programme maximum emphasis was given to practical and hands on canopy management and architectural engineering. Canopy management and plant architectural engineering of apple, pear, peach, kiwi fruit etc were demonstrated through lectures and on farm training.

Field demonstration on canopy management and certificate distribution to participants

Training programme conducted at Dirang

A three days training programme on "Basics of orchard establishment and management on scientific lines for high quality temperate fruit production in Arunachal Pradesh" was conducted at ICAR-CITH-RS, Dirang w.e.f. 17th to 19th Feb., 2017, in which 33 farmers of various villages of West Kameng district participated. The training programme was inaugurated in presence of Shri Jam Tsering (Zilla Parishad Member, Thembang Block Dirang) and Shri N. Poichulpa (Horticulturist, RAN, Dirang). During the training programme various lectures on different aspect of temperate fruit and vegetable production were thoroughly covered. Scientists of CITH, officers from horticulture department and SMS from KVK, Dirang delivered various lecture to the farmers. During the training programme along with oral lectures, practical demonstration on different aspects of temperate fruit production was also imparted to the participants. At the end of the training programme participation certificate as well as planting material (apple, apricot, peach, and walnut) and vegetables seed kit were distributed to the participants.

Training programmes for Department Personnel

The line departments are the main agencies between research and its implementation in farmer's field. ICAR-CITH Srinagar organized six one day training programmes/ farm visits for the officials of line departments/ scientists during the year. The details of training programmes conducting are presented in Table 37.


Training programme, farmer's participation and planting material distribution at Dirang, Arunachal Pradesh.

Table 37: Training Programme/ visits organized for line department personnel during 2016-17

Date	Organization	No. of participants	Organizer/ Facilitator
28.6.2016	One day Training programme/ visit Officers from NABARD	18	O C Sharma
21.12.16	One day Training programme/ visit Officers of line department during a training programme held at SKUAST-K w.e.f 20th to 22nd Dec, 2016	20	O C Sharma and J I Mir
15.3.2017	One day Training programme/ visit for officers of Deptt Agriculture, Srinagar on Reccent Technological Advances in temperate horticultural crop	20	D B Singh &O C Sharma
16.3.17	One day Training programme/ visit for officers of Deptt Agriculture, District Baramulla on Reccent Technological Advances in temperate horticultural crop	13	D B Singh &O C Sharma
7.3.17	Demonstrated various technologies generated at CITH to participants of Summer/ winter school held at SKUAST- K w.e.f. 21st Feb to 13th March, 2017	12	O C Sharma
21.3.17	Farm visit to scientists during a ten day training programme on Recent Descion Support System Tools: For Sustainable Precision Agriculture held at SKUAST-K w.e.f. 15 to 24th arch,2017	10	O C Sharma

Training/ visits of different groups of officers

Students visit/ trainings

The well established experimental orchards comprising large number of temperate horticultural crops and well established labs, ICAR-CITH has become the centre of learning for students and scholars. During the year six students groups visited the Institute and were trained on various aspects of temperate horticultural crops. The detail of various visits/trainings is presented in the Table 38.

Table 38: Training Programme/ visits organized for students

Date	Organization	No. of students	Organizer/ Facilitator
7.05.2017 2016 to 21.05.2016	In Plant of B.Tech students from SKUAST-K, Srinagar	19	D B Singh, O C Sharma & JI Mir
12.5.16	BSc. Hort students from Doon college, Dehradun	52	O C Sharma
13. 5. 2016	Choithram School, Indore, MP	12	J I Mir, Shafia Zaffer, S Jan
25.5.16	Govt Degree College, Baramulla	100	D B Singh, W Raja, J I Mir & Shoaib Kirmani
6.10.2016	BECON School, Rangreth	45 Students +19 Teacher	J I Mir, Shafia Zaffer, S Jan, S Zahoor & B APadder
26.2.17	Students of BSc. Agr , COA Wadura, SKUAST K under RAWE	50	O C Sharma & Shiv Lal
15.3.17-30.3.17	In Plant Training of SKUAST-K B.Tech students	29	J I Mir

Visit of student group to ICAR-CITH, Research farm.

Farmers visit / training

During the year 16 groups of farmers sponsored by various agencies from different areas visited the Institute and were made aware of various technologies generated at ICAR-CITH. The details of various programmes are presented in the Table 39.

Table 39: List of farmers group who visited ICAR-CITH during 2016-17 for one day training/ visit.

Sr No	Date	Area/District	No. of farmers	Organizer/ Facilitator
1	10.12.16	Poonch	37	O C Sharma & Shiv Lal
2	6.3.2017	Srinagar	47	O C Sharma & Mudasir Magray
3	14.3.17	Uri (Baramulla)	25	J I Mir
4	15.3.17	Beerwah (Budgam)	25	O C Sharma, S Zahoor & B A Padder
5	17.3.17	Khansahabib (Budgam)	25	M Rashid & B A Padder
6	17.3.17	Budgam	70	M Rashid & S Zahoor
7	18.3.17	Khansahib (Budgam)	25	O C Sharma & B A Padder
8	18.3.17	Chadoora (Budgam)	90	O C Sharma
9	18.3.17	Shopian	50	S Zahoor & B A Padder
10	20.3.17	Kupwara	7	J I Mir and B A Padder
11	20.3.17	Charae Sharief (Budgam)	40	O C Sharma
12	20.3.17	Budgam	30	W H Raja, M Rashid & B A Padder
13	22.3.17	Chadoora (Budgam)	56	Selvakumar R, S U Nabi and M Magray

Sr No	Date	Area/District	No. of farmers	Organizer/ Facilitator
14	23.3.17	Khansahib (Budgam)	40	Selvakumar, A Shabir and S Zahoor & Megna Rashid
15	23.3..17	Pulwama	35	S Zahoor and A Shabir
16	25.3.17	Tangmarg (Baramulla)	20	O C Sharma, S Zahoor, A Shabir and M Magray

Training and demonstration to farmers during their field visit

Days

The technologies generated on particular crops were disseminated by organizing different field days for exposure and the benefit of farmers (Table 40).

Table 40. List of days organized during 2016-17

Date	Day	Organizer/ Place	Facilitator
28-05-2016	Peach Day	CITH RS, Mukteshwar	Raj Narayan, Arun Kishore, Anil Kumar and S Devnath
11-08-2016	Apple Day	CITH RS, Mukteshwar	Raj Narayan, Arun Kishore, Anil Kumara and S Debnath

Glimpses of the Peach Day Programme organized on 28.05.2016 at CITH Mukteshwar

Exhibition

The ICAR-CITH, Srinagar and Regional Station Mukteshwar also displayed its technologies by putting exhibition stalls on various occasions and programs. The details of various exhibitions are presented in the Table 41.

Table 41: Participation in various exhibitions during the year

Date	Occasion	Organizer/ Place	Participating Scientist
9.4.16	Kisan Mela	VPKAS, Almora	Raj Narayan, Anil Kumar, Arun Kishore & S Debnath
24.9.16	Kisan Mela	VPKAS, Almora	Raj Narayan, Anil Kumar, Arun Kishore & S Debnath
17-18.9.16	Apple Festival	Kisan Bhawan, Dehradun	Raj Narayan, Anil Kumar, Arun Kishore & S Debnath
4.3.17	Awareness programme cum Kisan Sammelan on PMFBY	ICAR-CITH-KVK Baramulla	O C Sharma, J I Mir & W H Raja
15-17.3.17	Krishi Unnati Mela	New Delhi	W H Raja & M Magray
22 – 26.11.16	International Agronomy Congress	New Delhi	J I Mir
15 - 18 .11.16	7th Indian Horticulture Congress	HSI, New Delhi.	O C Sharma, J I Mir, Shiv Lal, K L Kumawat, W H Raja, K M Rai and Lal Chand

Glimpses of the Seb Mahotsava organized during 17-18 September, 2016 at Kisan Bhavan, Dehradun

Exhibitions of ICAR- CITH technologies and varieties during different occasions

Training Programme/ demonstrations conducted at Regional station, Mukteshwar

The continuous dissemination of technologies is also going on at ICAR Regional Station, Mukteshwar for the benefit of farmers. The programmes conducted during the year are presented in the Table 42.

Table 42: Trainings, demonstration and awareness etc. organized/conducted at Mukteshwar

S. No.	Date	Village	Name of Programme	Activities	No. of farmer
1.	23/04/16	Hartola	Training	Nursery raising of vegetable crops using modern technique	27
2.	24/06/16	Sunkiya	Training	Architectural engineering/ canopy management/ training & pruning in major temperate fruit crops	4
3.	05/09/16	Sunkiya	Training	Vegetable seed production and plant disease management'	33
4.	28/11/16	Sunkiya	Training	Hybrid Seed production technology in vegetable crops.	8
5.	29/06/16	Sunkiya	Awareness programme	Insect/pest & disease management of pea field	4
6.	21/07/16	Sunkiya	Awareness programme	Soil, plant nutrition management for capsicum crops plant	3

S. No.	Date	Village	Name of Programme	Activities	No. of farmer
7.	07/12/16	Sunkiya	Awareness programme	Training and pruning in Temperate fruit crops.	11
8.	30/03/17	Sunkiya	Awareness Program	Distribution of soil test report card to the farmers	16
9.	10/11/16	Sunkiya	Awareness & Demonstration	Awareness & demonstration on planting of high value vegetable crops	3
10.	24/11/16	Sunkiya	Technology demonstration	Awareness on importance & cultivation of Garlic and Pea.	2
11.	28/11/16	Sunkiya	Training on Hybrid Seed production technology in vegetable crops	Awareness on in vegetable seed production technology. Demonstrated the hybridization technique of seed production in Tomato & Capsicum	8
12.	07/12/16	Sunkiya	Training	Demonstrated the training & pruning of temperate fruits	11
13.	26/1216	Sunkiya	Technology demonstration to improve the soil fertility.	Awareness on importance and application of FYM & VC in soil. Collected and analyzed soil samples of farmer's field.	16
14.	26/10/16	Sunkiya	Demonstration	Technology demonstration for open and protected cultivation of vegetables and Application of balanced dose of fertilizers and micro-nutrients in vegetable crops	4
15.	24/06/16	Sunkiya	Diagnosis	Diagnosed the diseases in tomato and capsicum	4
16.	23/07/16	Sunkiya	Demonstration	Management of powdery mildew disease and Weed management technology in vegetable crops (tomato, capsicum etc.)	11
17.	03/10/16	Sunkiya	Demonstration	Water harvesting	3
18.	10/11/16	Sunkiya	Demonstration	Planting of high value vegetable crops.	3
19.	24/11/16	Sunkiya	Demonstration	Planting/sowing methods of the Garlic, Pea.	3
20.	26/12/16	Sunkiya	Demonstration	Soil sampling and soil fertility management.	6
21.	21/03/17	Sunkiya	Demonstration	Distribution of micronutrient, fungicide and insecticide with IDM/IPM package for the management of major diseases and pests.	9
22.	08/02/17	Sunkiya	Demonstration	Planting of temperate fruit crops	6
23.	18/02/17	Kumbhali	Demonstration	Planting of temperate fruit crops	12
24.	18/11/16	Jur Kafun	Farmer meeting and demonstration	Awareness created & demonstrated planting of high value vegetable crops	9
25.	16/12/16	Jur Kafun	Training	Demonstrated training & pruning system in temperate fruit	13
26.	16/12//16	Jur Kafun	Awareness programme	Training and pruning in Temperate fruit crops	13

S. No.	Date	Village	Name of Programme	Activities	No. of farmer
27.	09/05/16	Jur Kafun	Training	Nursery raising in temperate horticultural crops a profitable venture' and Crop production technology	12
28.	21/07/16	Jur Kafun	Demonstration	IDM/IPM package for the management of major diseases and insect/pests	3
29	19-10-2016	CITH RS, Muktesh-war	Training	Protected cultivation on horticulture, flower and vegetable	100
29.	20/10/16	Jur Kafun	Demonstration	Nursery raising and planting in vegetable crops	8
30.	18/11/16	Jur Kafun	Farmer meeting-demonstration	High value vegetable crops (Lettuce, Broccoli, Chinese cabbage)	9
31.	13/02/17	Jur Kafun	Demonstration	Planting of temperate fruit crops	9
32.	28/03/17	Jur Kafun	Farmer meeting-demonstration	Seed production	4

Training programme for officer at Mukteshwar

Organized one day training programme cum field practical demonstration on Propagation of walnut as well as other temperate fruit crops to the officers of department of state forest on 23.06.2016 at forest nursery unit, Selalekh, Dhari, Nainital (UK).

Implementation of Mera Gaon Mera Gaurau Programme

Jammu and Kashmir

For implementation of Mera Gaon Mera Gaurav programme acquaintance of farmers of village Hatigaon, Anantnag and distribution of chilli seedlings to 20 families (beneficiaries) under this scheme was done on 23rd May, 2016. The beneficiaries visited ICAR-CITH, Srinagar on 23rd May, 2016 and they were shown the varieties and technologies developed by the Institute and were taken around the experimental farm of apple high density block, almond, walnut, peach, plum, kiwi fruit, olive etc. They were also taken to polyhouse block where protected and off-season cultivation of vegetables and flowers were demonstrated. In addition a team lead by Dr Javid Iqbal Mir, Senior Scientist, ICAR-CITH, Srinagar visited the Hatigaon village on 16th March, 2017 and distributed the planting material of apple, peach, plum, apricot, almond, walnut and vegetables among the beneficiaries of Mera Gaon Mera Gaurav at Hatigaon, Anantnag. Awareness about the importance of this scheme was provided to the farmers on this occasion and in addition a visit was made to see the performance of plants distributed in this village during 2016.

Uttarakhand

In this programme, village Sunkiya in Nainital District was selected and base line data was collected and compiled. Total of 14 various extension programmes viz., training, awareness, demonstration diagnosis visits were organized in Sunkiya village selected under MGMG. Besides demonstration on high yielding varieties of tomato, capsicum, broccoli, lettuce, garlic, peas, apple, peach, plum, apricot etc. were laidout. Likewise, technologies on protected vegetable cultivation, vermicomposting, rain water harvesting and high density temperate fruit crop planting, etc were transferred. Also, soil samples of the selected farmers in the village were collected, analyzed and soil analysis report was distributed to the concerned farmers under the MGMG programme.

Glimpses of various programmes and MGMG at Mukteshwar

Technology dissemination among the tribal farmers of Babanagri, Ganderbal under TSP Scheme

Babanagri, Ganderbal

Under Tribal Sub-Plan project planting material of apple, walnut, apricot, cherry, almond and vegetables were distributed among the identified tribal farmers of Babanagri, Ganderbal on 16th February, 2017. Scientific team led by Dr Javid Iqbal Mir, inspected the performance of plants distributed among the tribal farmers during previous years. Farmers in this region have developed great interest in adoption of technologies developed by ICAR-CITH, Srinagar. Plants of apple, walnut, apricot, cherry and almond distributed under this project previously are showing very good performance with respect to vegetative characteristics and in coming years these plants will come to bearing and their performance will be evaluated.

One day training programme was organized by ICAR-CITH, Srinagar on 16th February, 2017 to 75 tribal farmers of Babanagri, Ganderbal. During the training programme Dr Javid Iqbal Mir, Scientist, ICAR-CITH, Srinagar enlighten the farmers about the importance of high density plantation for increasing productivity in apple, almond, cherry and apricot. Use of high yielding spur type cultivars, clonal rootstocks, pollination management, nutrient and fertilizer management etc was emphasized and the participants showed interest in adoption of such technology for the betterment of their livelihood.

Technology dissemination among the tribal farmers of Babanagri, Ganderbal under TSP Scheme

Technology dessemination among the tribal farmers of Rajauri under TSP Scheme

Planting material distribution among the tribal farmers of district Rajouri was done on 27-12-2016 to 29-12-2016. Distribution of quality planting material of temperate fruits, nuts and vegetables was done by Dr Wasim Hassan Raja, Scientist and Mr Shoaib Kirmani, Senior Technical Officer, CITH, Srinagar.

Technology dissemination among the tribal farmers of Rajouri under TSP Scheme

Two training programme were organized on 28-01-2016 on "Basics of orchard establishment and aftercare and maintenance and Practical demonstration of training and pruning of temperate fruits. Along with Chief Horticulture officer and horticulture development officers of Rajouri, 25 tribal farmers attended the training programme. The CHO stressed upon the framers to adopt the latest technologies, crops and varieties suitable for the area particularly Hazelnut which has been found to be having great potential for the district. The CHO also requested Director CITH to devise the technologies related to production of quality material of Hazelnut for wide spread cultivation in the area.

Training and demonstrations to the farmers of district Rajouri

Technology dissemination among the tribal farmers of Banni area of district Kathua under TSP Scheme

A three day training programmed was organized and demonstrations on various horticultural crops were laid out in tribal farmers field in Banni area of district Kathua. The farmers were also made aware of various technologies developed by CITH on temperate horticultural crops.

Planting material distribution cum training programme at Bani, District Kathua

Radio and TV programme

The scientists of ICAR- CITH, Srinagar are continuously disseminating the technologies through media also. A number of Radio/ TV talks and news paper coverage were provided during the report period. The detail of TV / Radio talks is presented in the Table 43 below:

Table 43: Radio/ TV talks delivered by scientists during 2016-17

Sr No	Scientist	No of talks
1	Dr D B singh	5
2	Dr Raj Narayan	5
3.	Dr O C Sharma	1
4.	Dr Javid Iqbal Mir	5
5.	Dr Shiv Lal	2
6.	Dr Anil Kumar	3
7.	Dr Arun kishor	3
8.	Dr Geetika Malik	1
9.	Dr K L Kumawat	1
10.	Dr W H Raja	1

Trainings and Capacity Building

6

Participation in trainings

Dr. Desh Beer Singh, Director

- Attended 10th EDP on Leadership Development w.e.f. Feb 18-22th, 2017 at National Academy of Agricultural Research Management, Hyderabad.

Dr Anil Sharma, Sr Scientist (Soil Science)

- Attended one day training on RTI online portal of DoPT at New Delhi on 13.10.2016
- Attended 03 days training on competency enhancement programme for effective implementation of Training functions by HRD Nodal Officers of ICAR, w.e.f. 20th – 22nd Feb., 2017.

Dr Anil Kumar, Scientist (Plant Pathology)

- Attended 5 days training programme on pest risk analysis organized by NIPHM, Hyderabad

Sajad Un Nabi Naingroo, Scientist (Plant Pathology)

- Successfully completed the orientation training at ICAR-CITH, Srinagar w.e.f. 13th Oct - 19th Dec. 2016
- Successfully completed Professional attachment training at Division of Plant Pathology SKUAST-K, Shalimar Srinagar w.e.f. 20th Dec. 2016 to 20th March 2017

Trainings attended by Administrative Staff

The details of various training programmes attended by different personnel working in administrative section are presented in Table 44.

Table 44. List of the administrative staff who attended trainings during 2016-17

S. No.	Name of employee	Designation	Discipline/ Section	Name of training	Duration (days)	Organizing Institute
				Programme attended		
1	Sh. Ramesh	AAO	Administration	MIS/FIS training	02	IASRI-New Dehli
2	Sh. Ramesh	AAO	Administration	CPP Portal training	02	IASRI, New Delhi
3	Sh. Diwan Chandra	Asstt.	Administration	MIS/FIS training	02	IASRI-New Dehli
4	Sh. Diwan Chandra	Asstt.	Administration	CPP Portal training	02	IASRI-New Dehli
5.	Sh. Akhil Thukral	AAO	Administration	MIS/FIS training	02	IASRI-New Dehli
6.	Sh. Mukul Raj Singh	AO	Administration	Public Procurement	06	NIFM, Faridabad

Trainings attended by Technical Staff

The details of various training programmes attended by different technical staff are presented in Table 45

Table 45: List of the Technical staff who attended trainings during 2016-17

S. No.	Name of employee	Designation	Discipline/ Section	Name of training Programme attended	Duration (days)	Organizing Institute
1	Sh. Shoaib Nissar Kirmani	Sr. Technical Officer	Field	High-tech propagation and nursery management for production of quality planting material	9	IIHR, Bangaluru
2	Sh. Mohammad Mudasir Magray	Sr. Technical Officer	Field	Quality seed and planting material production in horticultural crops	11	Deptt. of Horticulture UAS, Raichur
3	Sh. Vinod Chandra	Technical Officer	Field	Competence enhancement programme on motivation and positive thinking	10	NAARM, Hyderabad
4	Sh. Ajaz Ahmad Wani	Technician	Field	Operation and maintenance of improved implement and machinery for technical officers of ICAR Institutes	6	CIAE, Bhopal
5	Sh. Shoaib Nissar Kirmani	Sr. Technical Officer	Field	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
6	Sh. Mohammad Mudasir Magray	Sr. Technical Officer	Field	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
7	Sh. Ishtiyaq Ahmad Sheikh	Technician	Field	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
8	Sh. Ajaz Ahmad Wani	Technician	Field	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
9	Smt. Mubeena	Technician	Lab.	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
10	Sh. Farman Ali	Technical Assisstant	Workshop	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
11	Sh. Mehraj Ud Din Bhat	Technical Assisstant	Workshop	Canopy Management and Plant architectural engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
12	Sh. Mustaq Ahmed	Technician	Lab.	Canopy Management and Plant architect engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar
13	Sh. Ramzan Wani	Technician	Lab.	Canopy Management and Plant architect engineering on Temperate fruit crops	03	ICAR-CITH, Srinagar

Trainings attended by Supporting Staff

The details of various training programmes attended by different Supporting staff are presented in Table 46.

Table 46: Training by SSS of ICAR-CITH

S. No.	Name of employee	Designation	Discipline/ Section	Name of training	Duration (days)
				Programme attended	
1	Shri Bashir Ahmad Dar	SSS	Field	Handling of various equipments, Instruments, Farm Machinery, Farm Implements, Official Files, Documents Dissemination, Nursery Management and Motivation at Work.	3
2	Shri Showkat Ahmad Dar	SSS	Field		
3	Shri Bashir Ahmad Ganai	SSS	Field		
4	Shri Zubair Ahmad Swathi	SSS	Field		
5	Shri Madan Lal	SSS	Office		
6	Shri Narayan Singh	SSS	Field		
7	Shri Govind Giri	SSS	Office		
8	Shri Gh. Nabi Bhat	SSS	Office		
9	Shri Khushi Ram	SSS	Office		
10	Shri Shabir Ahmad Mir	SSS	Field		

Trainings organized for Skilled Supporting staff

A three days training programme on Handling of various equipments, Instruments, Farm Machinery, Farm Implements, Official Files, Documents Dissemination, Nursery Management and Motivation at Work for skilled supporting staff of ICAR during 28th to 30th December, 2016

HRD Fund Allocation and Utilization:

The budget allotted and utilized during the year under HRD is presented below in the Table 47.

Table 47. Budget utilization under HRD (Rs in Lakhs)

Head	Allocation	Expenditure
Plan	3.0	2.989
Non plan	0.5	0.30
Total	3.5	3.29

Three days training programme for Skilled Supporting staff of ICAR

Awards/Rewards/Recognition received during the year

7

- Dr Shiv Lal received **Best Oral Paper Presentation Award** in National conference of Fruit Breeding in Tropics and Subtropics - An Indian Perspective. Organized by Society of Promotion of Horticulture during April 27-29th , 2016, at IIHR, Bengaluru.

Dr Shiv Lal receiving Best Oral Paper Presentation award in National Conference and Gold Medal during convocation

- Dr Shiv Lal received **IARI merit medal (Gold medal)** for outstanding academic performance in Doctor of Philosophy programme. The award is conferred during 55th convocation of the IARI, New Delhi held on 9th Feb., 2017.
- Dr. Anil Kumar (Scientist, Plant Pathology) awarded with **Honorary Life Membership Certificate** by Asian PGPR Society of Sustainable Agriculture USA EIN: 47-4803807 Alabama, USA: 1309/490 in the month of April, 2016 in recognition and sincere appreciation of outstanding loyalty and dedication to this society. This honour recognizes the commitment demonstrated towards the programs, activities and vision of the Asian PGPR Society of Sustainable Agriculture.
- Dr. Anil Kumar (Scientist, Plant Pathology) received **Bharat Gaurav Award** from International Business Council (IBC), New Delhi during Seminar on "Socio-Economic Development" held on 25th July, 2016 at New Delhi for outstanding achievements in the field of Plant Pathology.
- Dr. Anil Kumar (Scientist, Plant Pathology) received **Rashtriya Gaurav Award** from International Friendship Society (IISC) during Seminar on "Economic Growth & National Integration" held on 25th March, 2017 at New Delhi for meritorious services, outstanding performance and remarkable role in the field of Plant Pathology.

Dr. Anil Kumar, receiving the Bharat Gurav Award and Rashtriya Gaurav Award

- Dr Selvakumar R received **Best Poster Award** for 'Genetic analysis of nutritional traits in tropical carrot (*Daucus carota* L.)' during 7th Indian Horticulture Congress held at ICAR-Indian Agricultural Research Institute, New Delhi, from 15-18th November 2016.
- Dr Selvakumar R. recieved **"Best Young Scientist Award"** for the Ph.D thesis entitled "Genetic studies on economic traits and molecular mapping for anthocyanin content in carrot (*Daucus carota* L.)" by Pear Foundation-A foundation for Educational Excellence during 'National Conference on Smart Summit-2016 (Science, Medicine, Agriculture, Research and Technology) on 10th December at Madurai.

Dr. Selvakumar R, receiving the Best Poster Award and Best Young Scientist Award

- Mr Sovan Devnath, Scientist (Soil Science) recieved '**Young Scientist Award**' for the oral presentation on 'Short-term changes in labile pools of organic carbon, microbial biomass and enzyme activities in soil under an organically managed peach (*Prunus persica* L.) orchard' in *11th Uttarakhand State Science and Technology Congress*, organized by Uttarakhand State Council for Science and Technology during 2-4th March, 2017 held at Dehradun.

Mr Sovan Devnath scientist (Soil Science) receiving Yong Scientist Award

- Dr O C Sharma, Sr. Scientist received **Outstanding Scientist Award 2016** by International Journal of Tropical Agriculture on 31st Dec,2016 during IJTA 4TH International Conference on Recent Advances in Agriculture and Horticulture Science held at Jodhpur during 30 to 31st Dec, 2016.
- ICAR-CITH, Regional Station Mukteshwar received **Second Prize** for producing best quality apple (Skyline Supreme) in the competition on apple exhibition in National Apple Festival Cum Workshop jointly organized by Department of Horticulture and Food Processing and State Horticulture Mission during 17-18th September, 2016.

Dr O C Sharma Sr Scientist receiving Outstanding Scientist Award 2016 during International Conference at Jodhpur

Publications

8

Research Papers (International/ National)

1. Attri BL, Mer MS, Kumar A, Narayan R, and Kishor A. 2016. Phyto-chemical characters of kiwi fruit (*Actinidia chinensis*) var. Allison affected by different stages of growth. *Annals of Horticulture* 9(1): 53-57.
2. Brijwal M, Dimri DC, Kishor A and Mishra DS. 2016. Effect of pollination methods on fruit set and physical characteristics of litchi fruits. *Indian Journal of Horticulture* 73(2): 165-170.
3. Brijwal M, Dimri DC, Kishor A, Mishra DS, Tiwari VK and Mer MS. 2017. Effect of plant bio-regulators and micro-nutrient on chemical characteristics of Litchi (*Litchi chinensis* Sonn.). *Ecology Environment & Conservation*, 23 (February Suppl.): S71-S74.
4. Govindasamy V, Raina SK, George P, Kumar M, Rane J, Minhas PS, Vittal KPR. 2017. Functional and phylogenetic diversity of cultivable rhizobacterial endophytes of sorghum (*Sorghum bicolor* (L.) Moench). *Antonie Van Leeuwenhoek*. DOI. 10.1007/ s10482-017-0864-0
5. Khan KA, Nabi SU, Dar MS , Khan NA. 2017.Correlation of different weather parameters with Blumeriella Leaf Spot Disease development and disease intensity in Kashmir Valley. *Environment* & *Ecology* 35 (1):165—168.
6. Khan KA, Nabi SU, Khan NA. 2016. Evaluation of different fungicides for effective management of Blumeriella Leaf Spot of cherry in Kashmir valley. *Indian Phytopathology* 69(3): 314-315.
7. Khan KA, Nabi SU, Khan NA. 2017. Identification of *Cylindrosporium padi* associated with leaf spot disease of cherry in Kashmir Valley. India. *Journal of Phytopathology and Pest Management* 3(3): 43-52
8. Kishor A, Attri BL, Brijwal M, Kumar A, Narayan R, Singh DB, Debnath S, Mer MS and Tiwari VK. 2016. Physico-chemical characterization of wild apple (*Malus baccata*) in Kumaon hills of Uttarakhand. *Ecology Environment* & *Conservation*. 22 (December Suppl.): S285-S289.
9. Kishor A, Verma SK, Brijwal M, Kumar A, Attri BL, Narayan R. and Debnath S. 2017. Evaluation of genetic diversity in wild pear (*Pyrus pashia*) under Kumaon hills of Uttarakhand. *Environment* & *Ecology* 35 (1B): 524-529.
10. Kumar A and Sharma JN. 2016. Evaluation of post-symptom activities of fungicides against *Marssonina coronaria* causing premature leaf fall in apple. *Indian Phytopathology* 69(3): 278-285.
11. Kumar D, Lal S and Ahmed N. 2016. Genetic diversity among plum genotypes in North West Himalayan region of India. *Indian Journal of Agricultural Sciences* 86(5): 666–72.
12. Kumar M, Raina SK, Govindasamy V, Singh AK, Choudhary RL, Rane J and Minhas PS. 2017. Assimilates mobilization, stable canopy temperature and expression of expansin stabilizes grain weight in wheat cultivar LOK-1 under different soil moisture conditions. *Botanical Studies* 58:14.
13. Lal S and Singh DB. 2016. Genetic divergence among 22 strawberry (*Fragaria x Ananassa*

Duch.) genotypes for bioactive compounds grown in northwest Himalayas. *SAARC Journal of Agriculture* 14 (1): 81-91.

14. Lal S, Ahmed N, Verma MK, Sharma OC and Mir JI. 2017. Genetic variability, character association and path analysis for yield and yield contributing traits in peach. *Indian Journal of Horticulture* 73 (4): 465-469.
15. Lal S, Singh SK and Srivastav M. 2017. Phenotyping of mango genotypes for fruit shape and size related traits for association mapping studies. *Green Farming* 8(1):75-79.
16. Lal S, Singh SK, Singh AK, Srivastava M, Singh A and Singh NK. 2016. Character association and path analysis for fruit chromatic, physico-chemical and yield attributes in mango (*Mangifera indica* L.). *Indian Journal of Agriculture Sciences*. 87(1):122-126.
17. Malik Hussain Aabid, Nathar Varsha Nitin, Mir JI. 2017. GC-MS analysis of methanolic extracts of *Ruta graveolens* L. for bioactive compounds. *Am. J. PharmTech Res*. 7(2):315-324.
18. Mer Mukesh, Attri BL, Kumar Anil and Narayan Raj. 2016. Varietal performance in physio-chemical properties of peach (*Prunus persica*) grown in Uttarakhand, India. *Agriculture Science Digest* 36(1): 75-77.
19. Mir JI, Ahmed N, Singh DB, Sharma OC, Sharma A, Shafi W, Zaffer S and Hamid A. 2016. Effect of planting densities on productivity of different cultivars in apple (*Malus x domestica*). *Indian Journal of Agricultural Sciences* 86 (8):1059-62
20. Mir JI, Qadri RA, Ahmed N, Khan MH, Shafi W, Zaffar S and Hamid A 2016. Morphological and biochemical variants of saffron potential candidates for crop improvement. *Journal of Cell and Tissue Research*. 16(1):1-8.
21. Raina SK, Govindasamy V, Mahesh K, Singh AK, Rane J, Minhas PS. 2016. Genetic variation in physiological responses of mungbeans (*Vigna radiata* (L.)Wilczek) to drought. *Acta Physiologae Plantarum*. 38: 268
22. Raina SK. 2017. Wounding activates a 47 k Da MAP Kinase in *Catharanthus roseus* (L.) G. Don. *Indian Journal of Experimental Biology*. 55: 107-112.
23. Sajjanar B, Deb R, Raina SK, Pawar S, Brahmane MP, Nirmale AV, Kurade NP, Manjunathareddy GB, Bal SK, Singh NP. 2017. Untranslated regions (UTRs) orchestrate translation reprogramming in cellular stress responses. *Journal of Thermal Biology* 65: 69–75.
24. Shah UN, Mir JI, Ahmed N, Fazili KM. 2016. Assessment of germplasm diversity and genetic relationships among walnut (*Juglans regia* L.) genotypes through microsatellite markers. *Journal of the Saudi Society of Agricultural Sciences*. Doi.org/10.016/j.jssas.2016.07.005.
25. Sharma A, Sharma V, Arora S, Arya VM, Maruthi GR and Jalali VK. 2016. Potassium fixation capabilities of some Inceptisols belonging to plain and sub-mountain region. *Journal of the Indian Society of Soil Science*. 64(4): 368-380.
26. Sharma OC, Singh DB, Zahoor S, Padder BA and Haji SA.2016. Gynodioecious behavior in some walnut genotypes-a new report. *Journal of Hill Agriculture* 7(2):283-285.
27. Sharma OC, Singh DB, Zahoor S, Padder BA and Haji SA. 2016. Shoot deformation in alstroemeria- a new report. *Journal of Hill Agriculture* 7(2): 286-287.
28. Singh NK, Mahato AK, Jayaswal PK, Singh A, Singh S, Singh N, Rai V, Mithra ASV, Gaikwad K, Sharma N, Lal S. 2016. Origin, diversity and genome sequence of mango (*Mangifera indica* L.). *Indian Journal of History of Science* 51(2): 355-368.

Review Article

1. Khan FA, Maqbool, Raj Narayan, S Bhat, SA Narayan and Khan FU. 2016. Reversal of Age-included seed deterioration though priming in vegetable crops- A review. *Advances in Plants and Agricultural Research*. 4(6): 00159. DOI : 10 15406/ apar. 2016. 04.00159.
2. Nabi SU, Raja WH, Dar MS, Kirmani SN and Magray MM 2017. New Generation Fungicides in Disease Management of Horticultural Crops. *Indian Horticulture Journal* 7(1): 01-07.
3. Raj Anup and Sharma Om Chand 2017. Enthnomedicinal usage,phytochemicals and biological activities of oleaster- an underutilized fruit. *Journal of Hill Agriculture* 8(1): 1-9.
4. Sharma N, Singh SK and Lal S. 2016. Transgenic research in fruit crops:Current status. *Advancement in genetic engineering* 5 (3): 1000155.
5. Sharma N, Singh SK, Lal S and Singh NK 2016. Genome sequence information in fruit crops: Current status. *Transcriptomics* 4:1
6. Sheikh AA, Wani MA, Bano PA, Nabi SU, Bhat TA, Bhat Mohammad A and Dar M S 2017. An overview on resistance of insect pests against Bt Crops, *Journal of Entomology and Zoology studies* 5(1): 941-948.
7. Yousuf N, Dar SA, Gulzar S, Nabi SU, Mukhtar S, and Lone RA. 2017. Terminator Technology:Perception and concerns for seed industry. *International Journal of Pure Applied Bioscience* 5(1): 893-900

Technical bulletin

1. Ahmed N, Singh DB, Srivastava KK, Mir, JI, Sharma OC, Sharma A. and Raja WH 2016. Scientific Apple Cultivation. Published by Director, CITH, Srinagar. Technical Bulletin 1/2016, 48p
2. Akbar SA, Dar MA, Dar SA and Raja WH. 2017. *Sinakhati guide motadal phalon ke ahm kiro ke liye.* Published by Director, CITH, Srinagar, 27p
3. Ganeshmurthy, AN, Sharma A, Singh DB, Ahmed N, Raja RHS, Mir JI, Sharma OC and Chand L. 2016. Soil fertility and crop nutrition in apple, peach and plum: Delineation, Deficiencies and management of nutrients. Published by Director, CITH, Srinagar. , 38p
4. Mahendiran G, Akbar SA and Dar MA. 2016. Illustrated field identification guide for major pests of temperate fruit crops. Published by Director, CITH, Srinagar , 31p
5. Mir JI, Ahmed N, Singh DB, Sharma OC, Mahendiran G, Lal S, Shafi W. 2016. Technology inventory. Published By Director ICAR-CITH, Srinagar, . pp 31
6. Singh DB, Kumar D, Ahmed N, Mir JI and Sharma OC. 2016. Bulletin on Post harvest management and processing of apricot. Published by Director, CITH, Srinagar. Technical Bulletin 2/2016, 27p

Books

Lal S, Verma MK, Ahmed N, Singh DB. 2016. Olive: Improvement, Production and Processing. New Delhi, Daya Publishing House. 224p

Mir JI, Qadri R and Ahmed N. 2016. Clonal identification and molecular characterization of saffron. LAP Lambert Academic Publishing. ISBN-10:3659904759. 120p

Razvi S, Sharma A and Nautiyal S. 2017. Agroforestry. New Delhi, Ramesh Publishing House,260p

Popular Articles

- Devnath S, Attri BL, Kumar A, Narayan R and Kishor A. 2016. *Setoshan phalon mein suksham poshak tatwon ka prabandh. Phal Phool* 37(1): 22-24

- Kishor A, Narayan R, Kumar A, Brijwal M and Debnath S. 2016. *Seb me saghan bagvani paddhati: mahetv tatha labh.* Smarika, Rashtriy Sangoshthi on badalte jalvayu parivesh me seb utpadan: chunautiya evam ranneeti jointly organized by Department of Horticulture and Food Processing and State Horticulture Mission, Uttarakhand at kisan bhavan Dehradun during 17-18th September, 2016, pp. 5-7.
- Singh S R, Ahmed N, Ranhan J K, Singh D B, Mir J I and Nusrat Jan 2016. CITH Garlic-1 – a new garlic variety. *Indian Horticulture*. 61(4):30-32
- Singh DB and Lal S. 2016. Rose hip: a potential future crop for processing and value addition. *Indian Horticulture*. 61(3):15-23.

Book chapters

- Ahmed N, Gupta AK, Kumawat KL and Mir JI. 2017. Distant hybridization for improvement of temperate fruit and nuts. *In:* Distant hybridization in horticultural crops. (Edited by M.R. Dinesh and M. Sankaran). Daya Publishing House, New Delhi-110 002. (INDIA), pp 25-44.
- Ahmed N, Pandit AH, Mir JI and Hussain K 2016. Canopy Architecture and HDP in temperate fruits: An innovative approach for doubling farmer's income. *In:* Doubling Farmers income through Horticulture, Edited by Chadha et al. , pp 175-190
- Mir JI, Singh DB, Ahmed N, Sharma OC, Sharma A, Lal S, Raja WH and Jan A. 2016. Impact of climate change on apple production and strategies for mitigating its effects. *In:* Doubling Farmers income through Horticulture, Edited by Chadha *et al.*, pp 807-816
- Narayan R, Nrayan S and Singh AK. 2017. Brinjal. *In:* Organic crop production: principal and practices vol. II, (Edited by: JP Sharma). New Delhi, Kalyani Publishers (in press)
- Narayan R, Singh PK, Narayan S and Singh AK 2017. Onion. *In* : Organic crop production: principal and practices vol. II, (Edited by: JP Sharma). New Delhi, Kalyani Publishers (in press)
- Narayan S, Narayan R, and Singh AK 2017. Chili. *In* : Organic crop production: principal and practices vol. II, (Edited by: JP Sharma). Kalyani Publishers, New Delhi. pp (in press)

Participation in Workshops/Conferences/ Meetings

9

Dr. Desh Beer Singh, Director

- Attended RCM-III at GB Pant University of Agriculture and Technology, Pant Nagar from 30-31st May, 2016.
- Attended consortium of Hill Research Institutes meeting on 12.12.2016 held at ICAR-Research Complex for NEH region, Shillong, Meghalaya
- Attended 7th Indian Horticulture Congress on Doubling Farmer Income through horticulture organized by HSI New Delhi from Nov. 15 to 18 2017 at New Delhi.
- Attended 4th Group Discussion of ICAR-AICRP on fruits held at IIHR Bangaluru w.e.f 4-5th January, 2017
- Attended RCM-III on 10th July, 2017 at ICAR-Research Complex for NEH region, Shillong, Meghalaya
- Attended Directors Conference held at ICAR, New Delhi w.e.f. 14 to 15th February, 2017

Dr. Raj Narayan, Principal Scientist (Hort. Science)

- Attended Annual Group meeting of AINRP (O&G) at CSAUAT Kanpur from 3 to 4th April, 2016
- Attended Annual Group meeting of AICRP (Veg.) at ICAR-IARI, Pusa New Delhi from 10-12 May, 2016
- Attended national Seminar on "Recent trends and future prospects in sustainable agriculture with reference to climate change held from 18 to 19 March, 2017 at Janta College, Bakewar, Etawah (UP), CSJM University, Kanpur

Dr. O C Sharma, Sr Scientist (Fruit Science)

- Attended 7th Indian Horticulture Congress 2016 organized by HSI held at Pusa, New Delhi w.e.f.15 to 18 Nov, 2016
- Attended IJTA 4TH International Conference on Recent Advances in Agriculture and Horticulture Science held at Jodhpur w.e.f.30 to 31st Dec,2016

Dr. J. I. Mir, Scientist, Sr Scale (Biotechnology)

- Attended 1st International Agro biodiversity Congress, November 6-9, 2016, New Delhi India.
- Attended 7th Indian Horticulture Congress on Doubling farmers income through horticulture, organized by HSI, New Delhi from November 15-18, 2016 at New Delhi.
- Attended 4th International Agronomy Congress on Agronomy on sustainable management of natural resource, environment, energy, and livelihood security to achieve zero hunger challenge from November 22-26, 2016 at New Delhi, India.
- Attended 19th Annual National Conference SSCA-2017 on Statistics and Informatics in Agricultural and Allied Sciences from March 06-08, 2017 at SKUAST-J.
- Attended DUS review meeting held at IGKV, Raipur during Feb 27-March 01, 2017.
- Attended 9th Review Meeting of DUS test centers held at JAU on 9th March, 2015.

Dr Shiv Lal, Scientist, Sr Scale (Fruit Science)

- Attended National Conference on "Fruit Breeding in Tropics and Subtropics- An Indian Perspective during April 27-29th, 2016 at IIHR, Bengaluru.
- Attended 7th Indian Horticulture Congress- An International Meet for Doubling Farmers Income through Horticulture during November 15-18, 2016 held at ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi.
- Attended brain storming session cum interaction meet on engineering interventions in horticultural crops during Oct. 24-25th, 2016 held at CIAE Bhopal.

Dr. Anil Kumar, Scientist (Plant Pathology)

- Attended Seminar on Socio-Economic Development organized by International Business Council (IBC), held on 25th July, 2016 at New Delhi
- Attended Seminar on Economic Growth & National Integration organized by India International Friendship Society (IISC), held on 25th March, 2017 at New Delhi.

Dr. Arun Kishor, Scientist (Fruit Science)

- Attended 7th Indian Horticulture Congress, Doubling the farmer income through horticulture *w.e.f.* 15-18th November, 2016, at Pusa Campus, New Delhi, India.
-

Sh. Sovan Devnath, scientist (Soil Sicence)

- Attended 11th Uttarakhand State Science and Technology Congress, organized by Uttarakhand State Council for Science and Technology during 2-4th March, 2017 held at Dehradun.
- Attended National Seminar on Developments in Soil Science: 2016 held at RVSKVV, Gwalior w.e.f. 20-23rd October, 2016. (81st Annual Convention of the Indian Society of Soil Science)

Dr. K. L. Kumawat, Scientist (Fruit Science)

- Attended 7th Indian Horticulture Congress on Doubling farmers income through horticulture, organized by HSI, New Delhi from 15th to 18th November, 2016 at New Delhi.
- Attended National Annual Review Workshop of the National Innovations on Climate Resilient Agriculture (NICRA) project held at NASC, New Delhi from 9-10 Dec., 2016.

Dr. Wasim Hassan Raja, Scientist (Fruit Science)

- Attended 7th Indian Horticulture Congress on Doubling farmers income through horticulture, organized by HSI, New Delhi from 15th to 18th November, 2016 at New Delhi.

Shri Lal Chand, Scientist (Fruit Science)

- Attended 7th Indian Horticulture Congress on Doubling farmers income through horticulture, organized by HSI, New Delhi from 15th to 18th November, 2016 at New Delhi.
- Attended Fourth Annual National Workshop of IHR States (NWHRS-2017) Under NMSHE held at New Delhi from 30th - 31st January, 2017.

Dr. K. M. Rai, Scientist (Fruit Science)

- Attended 7th Indian Horticulture Congress on Doubling farmers income through horticulture, organized by HSI, New Delhi from 15th to 18th November, 2016 at New Delhi.

Selvakumar R, Scientist (Vegetable Science)

- Attended 7th Indian Horticulture Congress-2016 held at ICAR-Indian Agricultural Research Institute, New Delhi w.e.f. 15-18th November, 2016.
- Attended 3rd Indian Biodiversity Congress-2017 held at Pondicherry University, Pondicherry w.e.f. 10-12th March, 2017.

List of Ongoing Projects

10

Institute Research Projects	
A. Project: Crop improvement and Biotechnology **Sub projects:**	
1.	Survey, collection, characterization and documentation of temperate horticultural crops (CITH-01)
2.	Breeding for development of superior varieties/hybrids in Solanaceous vegetables (CITH–07)
3.	Development of superior cultivars/ hybrids in temperate fruits through conventional and non conventional methods (CITH-40)
4.	Development of CMS lines in long day onion [*Allium cepa* L] (CITH-70)
5.	Characterization and diversity analysis for flowering related gene/ genes in almond (CITH-72)
6.	Diagnosis and prognosis of apple viral diseases (CITH-75)
7.	Breeding for nutra-rich varieties/hybrids in root vegetable crops (CITH-74)
B. Project: Crop Production and Propagation **Sub projects:**	
1.	Divulging the adept mode of fertilizer application to optimize saffron yield (CITH 60)
2.	Fertigation: An efficient soil management stratagem for escalating nutrient and water use efficiency in apple (CITH 61)
3.	Aquatic dissipate management (ADM) through vermitechnology (CITH 62)
4.	Development of almond based saffron inter cropping system (CITH 11)
5.	Effect of various training and pruning systems in Persian walnut (CITH-54)
6.	Standardization of integrated nutrient management of vegetables as intercrop in apple orchard (CITH-57)
7.	Characterization of soil nutritional survey in apple and peach growing areas of Uttrakhand (CITH-64)
8.	Standardization of growing /nutrients media and growing conditions for the cost effective production of quality vegetables and their seedlings (CITH-65)
9.	Development of diversification technology for round the year vegetable crops under mid and high hills of Uttrakhand (CITH-66)
10.	Enhancing feathering through plant growth regulators for high quality nursery production in apple (CITH-71)

	Institute Research Projects
11.	Evaluation of different substrates and systems for soilless strawberry production (*Fragaria x ananassa Duch.*) (CITH-76)
	C. Project: Crop Protection **Sub projects:**
1.	Management of major soil born diseases of apple (CITH-55)
2.	Development of spray schedule against major canker and foliar diseases of apple in Uttarakhand (CITH-56)
	D. Project: Post Harvest Management **Sub projects:**
1.	Studies on dried prunes in relation to cultivars and drying technology (CITH-67)
2.	Standardization of technology for blending of temperate stone fruit juice (CITH-68)
3.	Assessment of Kashmiri chilli for commercial traits (CITH-69)
4.	Effect of packaging systems and storage conditions on quality retention of shelled walnut (CITH-73)
	E. Ongoing externally funded projects **Sub projects:**
1.	Network project on outreach of technologies for temperate fruit crops (Main centre)
2.	Network project on onion and garlic (co-operation centre)
3.	All India Coordinated Research Project on Vegetable Crops
4.	Intellectual property management and transfer/ commercialization of agricultural technology scheme
5.	National saffron Mission for economic revival of J & K saffron sector
6.	Consortium research platform on borers
7.	National initiative on climate resilient agriculture (NICRA)
8.	Micronutrient management in horticultural crops
9.	Consortia research platform on fungal foliar diseases
10.	CRP on agro biodiversity
11.	Challenge programme on canopy management and plant architectural engineering in temperate fruits (Main Centre)
12.	DUS testing centre for temperate fruits
13.	National Mission for Sustaining Himalayan Eco system (NMSHE-TF-6)
14.	Livelihood and Nutritional Improvement of Tribal Farm Women through Horticulure

Research Review and Management Committees

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Research Advisory Committee of ICAR-CITH

1.	**Padma Shri Dr. K. L. Chadha,** Chairman, RAC, CITH, Srinagar, 7281, Sector-B, Pocket-10, Vasant Kunj, New Delhi	Chairman
2.	**Dr. B. Venkateswarlu,** Vice Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-431402, Maharastra	Member
3.	**Dr. A. A. Sofi,** Ex-Director, CITH, Srinagr, Iqbal Colony, Opposite Baba Marbels, HMT, Zainakot, Srinagar-190012 (J&K)	Member
4.	**Dr. V. V. Ramamurthy,** Ex-Professor, Division of Entomology, ICAR-IARI, New Delhi.	Member
5.	**Dr. Surinder K. Tikoo,** Director Research, Breeding and Dev Tierra Seed Science, Pvt Ltd D 18, Hill View Residency, Baner, Pune-411045, HO: Malaxmi Courtyard, Khajaguda, Hyderabad-500008, India	Member
6.	**Dr. J. L. Karihaloo,** Co-ordinator of APCAB, Asia Pacific Association of Agriculture Research Institution (APAARI), C/o ICRISAT, NASC, DPSM, New Delhi-110012	Member
7.	**Dr. Hina Shafi,** D/o Sh. M. S. Bhat, M.P. Lane, Kursu Rajbagh , Srinagar	Member
8.	**Shri Desh Kumar Nehru,** S/o Syam Lal, Panjla, Teh.: Rohama, Distt.: Baramulla (J&K)	Member
9.	**Dr. T. Janakiram** ADG (Hort-I), KAB-II, ICAR, New Delhi	Member
10.	**Dr. D. B. Singh,** Director (Acting), ICAR-CITH, Srinagar	Member
11.	**Dr. O. C. Sharma,** Sr. Scientist, ICAR-CITH, Srinagar	Member secretary

Institute Management Committee (IMC)

1.	**Dr. Desh Beer Singh** Director, ICAR-CITH, Srinagar	Chairman
2.	**Director Horticulture** Govt. of J&K, Raj Bagh, Srinagar	Member
3.	**Director** Horticulture and Food Processing, Department of Horticulture, Chaubattia Ranikhet, Almora (Uttarakhand)	Member
4.	**Prof. & Head** Div. of Fruit Science, SKUAST-K, Shalimar	Member
5.	**Dr. Hina Shafi Bhat** D/O Sh. M.S. Bhat R/O M.P. Lane Kursoo, Rajbagh, Srinagar -190008	Member / Progressive Farmer
6.	**Sh. Desh Kumar Nehru** S/O Sh. Sham Lal R/O Rohama, District Baramulla, J&K	Member / Progressive Farmer
7.	**Dr. Major Singh** Principal Scientist, Division of Crop Improvement, ICAR-IIVR, Varanasi	Member
8.	**Dr. O.P. Awasthi** Principal Scientist (Fruit Science), ICAR-IARI, New Delhi	Member
9.	**Dr. Anil Sharma** Senior Scientist, ICAR-CITH, Srinagar	Member
10.	**Dr. S.M. Sultan,** Senior Scientist and I/C, ICAR-NBPGR, Regional Station, Srinagar	Member
11.	**Asstt. Director General (HSI)** ICAR, KAB-II, Pusa, New Delhi-110012	Member/Council representative
12.	**Shri S.K. Sharma** F&AO, ICAR, Krishi Bhawan, New Delhi	Member
13.	**Shri Ramesh** AAO, ICAR-CITH, Srinagar	Member Secretary

Distinguished Visitors

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Visit of VIPs/ Dignitaries

- Hon'ble Director General, ICAR & Secretary DARE, Dr Trilochan Mohapatra, New Delhi visited ICAR-CITH, Regional Station Mukteshwar on 3rd July, 2016 and he was apprised regarding different activities

Dr Raj Narayan showing various varieties to Director General, ICAR and Secretary, DARE

- Shri Chhabilendra Raul, Additional Secretary DARE & Secretary ICAR, New Delhi visited ICAR-CITH, Regional Station Mukteshwar on 29th May, 2016 and he was shown various research and extension activities of station.

Dr D B Singh, Director briefing to Shri Chhabilendra Raul Additional Secretary DARE & Secretary ICAR, New Delhi

- Dr T. Jankiram, Additional Director General (Hort.), ICAR, New Delhi visited ICAR-CITH, Regional Station Mukteshwar on 30th May,2016 and various research activities of station were shown to him.

Dr T. Jankiram, Additional Director General (Hort.), ICAR, New Delhi discussing with scientists at Mukteshwar

- Shri Naeem Akhtar, Education Minister J&K visited ICAR- CITH, Srinagar on 31st October, 2016. He was made aware of various research activities being carried out by the Institute for the benefit of farmers.

Director ICAR-CITH, Srinagar depicting various activities to Mr Naeem Akhtar, Education Minister J&K

- Shri Chhabilendra Raul, Additional Secretary DARE & Secretary ICAR, New Delhi visited ICAR-CITH, Srinagar on 18th June, 2016 and he was briefed about various activities of the Institute.

Shri Chhabilendra Raul, Additional Secretary DARE & Secretary ICAR discussing various technologies developed at the Institute with Director and scientists of CITH Srinagar

Personnel

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ICAR-CITH Head Quarter, Srinagar

RMP

- Dr. D. B. Singh, Director

Scientific

- Dr. O. C Sharma, Senior Scientist (Fruit Science)
- Dr. Anil Sharma, Senior Scientist (Soil science)
- Dr. J.I. Mir, Senior Scientist (Plant Biotechnology)
- Dr. Shiv Lal, Scientist, Senior Scale (Fruit Science)
- Dr. Geetika Malik, Scientist (Vegetable Science)
- Dr. Kishan Lal Kumawat, Scientist (Fruit Science)
- Dr. Wasim Hassan Raja, Scientist (Fruit Science)
- Dr. Selvakumar R, Scientist (Vegetable Science)
- Mr Sajad Un Nabi Naingroo, Scientist (Plant Pathology)

Administrative

- Sh. Mukul, Raj Singh, Administrative Officer
- Sh. Fayaz Ahmad Dar, AF &AO
- Sh. Ramesh, Asstt. Admn. Officer
- Mrs. Shahida Rafiq, P.A. to Director
- Sh. Showkat Ahmad Mir, Assistant
- Sh. Reyaz Ahmad Mir, Assistant
- Sh. Mukhtar Ahmad, Assistant (KVK, Baramulla)
- Sh. Tariq Ahmad Mir, Jr. Stenographer
- Sh. Mehraj-ud-Din Meer, UDC
- Sh. Mohd. Muzafer Lone, LDC
- Sh. Rouf Ahmad Sheikh, LDC

Technical

- Sh Shoaib Nissar Kirmani, Senior Technical Officer
- Sh Mohammad Mudasir Magray, Senior Technical Officer
- Sh. Eshan Ahad, Tech. Officer
- Sh Muneer Ahmad Sheikh, Sr. Technical Assistant
- Sh. Mehraj-ud-din Bhat, Sr. Technical Assistant (Driver)
- Sh. Farman Ali, Sr. Technical Assistant (Driver)
- Sh. Mohammad Ramzan Wani, Technical Assistant (Lab.)
- Sh. Mushtaq Ahmad Khan, Technical Assistant (Lab.)
- Smt. Mubeena, Sr. Technican (Computer / Data Operator)
- Sh. Ajaz Ahmad Wani, Technician (Field)
- Sh Ishtiyaq Ahmad Sheikh, Sr.Technician (Field)

Skilled Supporting Staff

- Sh. Bashir Ahmad Dar,SSS
- Sh. Showkat Ahmad Dar, SSS
- Sh. Abdul Rashid Bhat,SSS (KVK, Baramulla)
- Sh. Bashir Ahmad Ganai, SSS.
- Sh. Zubair Ahmad Swathi, SSS
- Sh. Madan Lal, SSS.
- Sh. Khushi Ram, SSS
- Sh. Ghulam Nabi Bhat, SSS

Personnel at CITH-RS, Mukteshwar

Scientific staff

- Dr. Raj Narayan, Principal Scientist (Vegetable Science)
- Dr. Anil Kumar, Scientist (Plant Pathology)
- Dr. Arun Kishor, Scientist (Fruit Science)
- Sh. Sovan Debnath, Scientist (Soil Science)

Administrative

- Sh. Akhil Thukral, Asstt. Admn. Officer (On deputation)
- Sh. Diwan Chandra, Assistant
- Sh. Pushpendra Kumar, LDC

Technical staff

- Sh Vinod Chandra, Technical Officer
- Sh Puran Chandra, Senior Technician (Field)

Skilled Supporting staff:

- Sh. Narayan Singh, SSS
- Sh. Govind Giri, SSS
- Sh. Shabir Ahmad Mir, SSS

Appointments/Transfers/Deputation

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Appointments

- Dr D B Singh, Acting Director joined as permanent Director at ICAR- CITH, Srinagar on 7th July, 2016.
- Mr Sajad Un Nabi joined as Scientist (Plant Pathology) at ICAR-CITH, Srinagar on 13th October, 2016
- Sh Mukul Raj Singh joined as Administrative Officer at ICAR-CITH, Srinagar on 23rd Nov., 2016.

Transfers

- Dr. G. Mahendiran, Scientist (Agri. Entomology) transferred from ICAR-CITH, Srinagar to ICAR-NBAII, Bengaluru on 16th June, 2016.
- Sh. Lal Chand, Scientist (Fruit Science) transferred from CITH, Srinagar to ICAR-CAFRI, Jhansi on 8th March, 2017.
- Dr K M Rai Scientist (Fruit Science) transferred from ICAR- CITH, RS Mukteshwar to NBPGR, New Delhi on 22nd March, 2017.
- Dr Susheel Kumar Raina, Scientist (Plant Breeding) transferred from ICAR- CITH, Srinagar to NBPGR, New Delhi on 28th March, 2017.

Deputation

- Sh. Akhil Thukral, Asstt. Admn. Officer relieved on deputation to Competitive Commission of India, New Delhi on 11th November, 2016.

NOTE

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch